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WORLD PETROLEUM

NEW YORK AND LONDON

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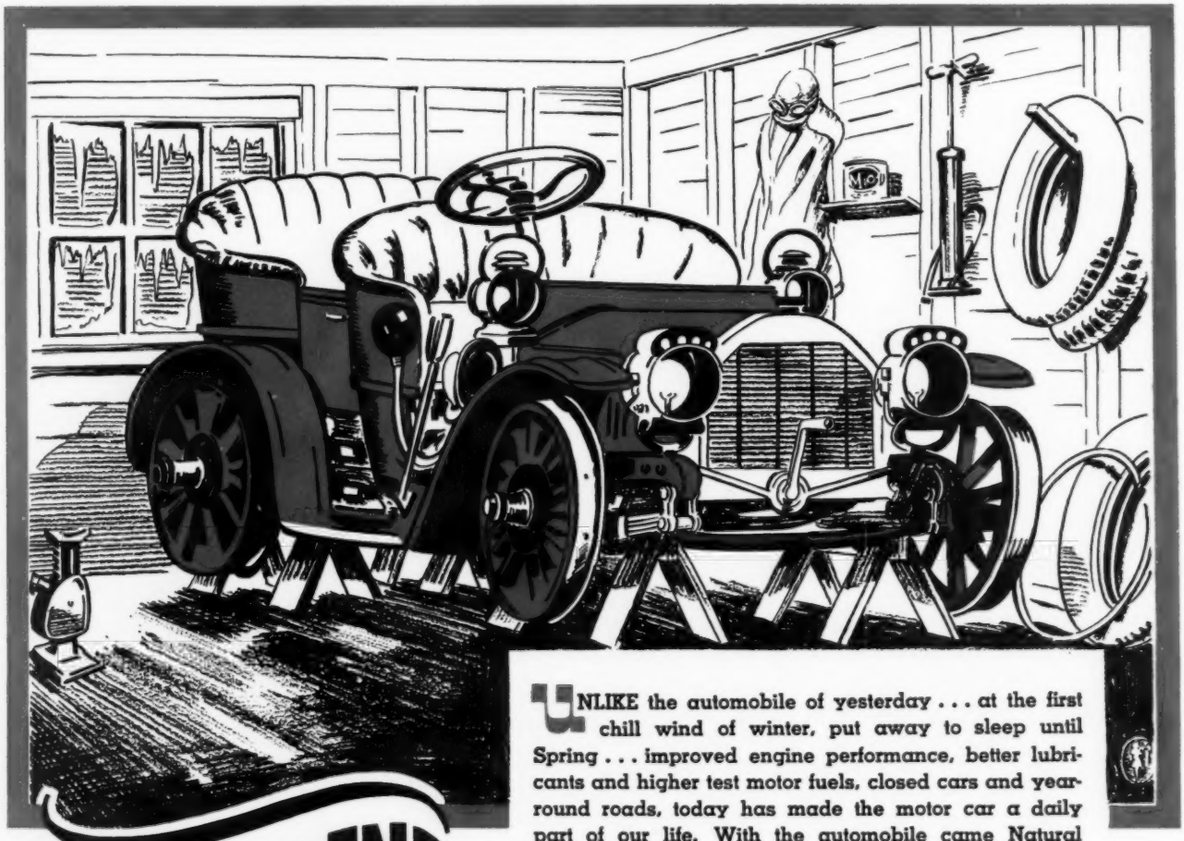

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Storage at Lone Star repressuring plant in Texas.

Photo by Ulric Meisel

EDITORIAL

SAUCE FOR THE GOOSE ONLY

OF all the men in public life in the United States whose activities affect the oil industry, one whose mental processes are most difficult to understand is Thurman W. Arnold, Assistant Attorney General and Trust Buster in Chief of the present Administration. This is not due to reticence on Mr. Arnold's part. He has written voluminously, has spoken frequently and apparently is ready to express himself at any time with or without prior preparation.

Possibly it is the very freedom with which Mr. Arnold discusses public issues, legal questions and the habits, thoughts and business ways of his fellow citizens that leads to confusion in the minds of the latter as to the ideas he is trying to establish. Whatever thesis he puts forward he defends vigorously and usually with enthusiasm. It is only when one attempts to put the conclusions that he advances side by side and to weave them into some sort of a logical pattern that a sense of bafflement and frustration is inescapable.

In his popular writings as in his interpretations of the federal laws against restraints of trade Mr. Arnold repeatedly has declared his devotion to, one might even say his passion for, free competition in all kinds of business. His advocacy of the time honored system of free and unhampered trade goes to the extent of upholding those forms of competition which are commonly described as destructive and which many authorities on merchandising criticize as being in the long run harmful alike to producer, middleman and consumer. Mr. Arnold is for the price cutter regardless of the damage the latter may spread in his own immediate field because of a belief that anything that lowers prices advantages the consumer, temporarily at least.

Judging from Mr. Arnold's own utterances his vision of an ideal business community is one in which bankruptcies are many, reorganizations frequent and the turnover of mercantile and manufacturing establishments high. Sales of bankrupt stocks on every block and the thud of the auctioneer's hammer disposing of mercantile wreckage are dear to his heart, not because he is cynical or callous but because in his view the consumers are getting the benefit of cheap commodities.

Mr. Arnold is for the consumer. He says so vociferously and it must be acknowledged with entire sincerity. Let the consumer be served is his motto. If, in this service, others are ruined and values that have been built up by long and honest endeavor are destroyed this apparently must be set down as the toll exacted by the competitive system.

In seeking the best interests of the consumer Mr. Arnold evidently goes to the length of believing that he should be forced to take the kind of cheap goods that are best for him regardless of his own wishes in the matter. He berates the automobile manufacturers, for example, for continuing to produce what he regards as costly automobiles and neglecting to turn out cars to be sold at one-half or one-third present prices. This in spite of the fact that every attempt to produce such cars has been a failure for the reason that American consumers of motor cars have shown very emphatically that they will not buy machines below the established standard of construction and performance.

Holding views as to the high importance of competition that may fairly be called extreme and that certainly are diametrically opposed to the beliefs of many of his fellow office holders in Washington one might reasonably expect Mr. Arnold to laud examples of strenuous competition wherever he comes across them. Such, however, is not the case. Recently he attacked oil companies for spending millions of dollars in advertising brands of fuel which he asserted were all pretty much alike and for erecting luxurious and showy service stations on every available street corner.

Now, as everyone knows who is in the least degree familiar with the oil industry, there is no business in which competition is carried to greater, and in many instances to more unreasonable, extremes than in the sale of motor fuel. The race for gallonage has led not only to extensive campaigns of advertising and to the

construction of ornate service stations but all too frequently to the sale of gasoline and other products at a loss. The marketing end of the oil business should meet with Mr. Arnold's warm approval for it is the happy hunting ground of the price cutter and price wars are always going on in one place or another. Some consumers certainly buy their gas cheaply while the war rages and the oil companies foot the bill.

This is not the angle from which Mr. Arnold chooses to view the matter. If the oil companies held on to the money they now spend on advertising and service stations, he says, they would be able to sell gasoline at still lower prices to the consumer. Under these circumstances, though Mr. Arnold does not pursue the subject, the consumer presumably would drive the family jalopy further and would use his savings to buy more gasoline.

Mr. Arnold's argument heads straight toward the age old controversy as to who pays for advertising. Many men who have given long and careful study to the subject hold that advertising, by increasing sales, spreads overhead and makes possible economies in manufacturing and distributing the larger volume called for to the extent that it ceases to be a tax either on producer or consumer. Mr. Arnold might not accept that reasoning but the fact that the greatest and most successful business concerns are the largest advertisers would seem to clothe it with some merit.

The service station issue is a distinctly minor one. The reason for clean, sanitary and eye-appealing stations is an advertising reason—they attract customers. If they fail to do this it must be admitted that the money spent on them is wasted. So the neat and picturesque filling station must stand or fall with the argument for sales promotional advertising.

Perhaps the search for a logical key to Mr. Arnold's laudation of competition in certain circumstances and his condemnation of it in others is a waste of effort. The more one studies his actions and his utterances the more certain it appears that the explanation is a simple one. Competition, in Mr. Arnold's book, may be good or bad according to the virtue inherent in those who practice it. Starting with the assumption that nothing good can come out of the oil industry it then becomes possible to assert that even when oil marketers pursue a form of competition that would be praiseworthy in others they must do it from sordid motives and a desire to defraud those on whose continued patronage and good will the very existence of every oil enterprise must depend.

Among the published works of Mr. Arnold is a book which appeared a few months ago under the intriguing title "The Bottlenecks of Business." Because of the author's influential position it has had a large sale among business men eager to understand Mr. Arnold's ideas of trade and of the methods necessary to keep it free from restraint. The book deals with many subjects, but one paragraph depicts a sales policy which the Assistant Attorney General attributes to oil companies and characterizes as taking the form of adding unnecessary luxuries to the distribution system. It is as follows:

> There is no difference in motor fuels because they had become standardized. Competition has become a race to see which company could put out the most expensive hokum. Millions have been spent in advertising different brands that were in fact all the same. Filling stations more luxurious than the homes of most of the customers appeared on every corner. Maps were given away free. Unnecessary services were added. Men were hired to smile at poor customers and say "Happy Motoring." All this meant that a greater share of the customer's dollar was going for gasoline. The government relief check filled the gap and helped pay for that hokum.

All of which means, if it means anything, and it perhaps should be mentioned that the book is not intentionally humorous, that the oil companies deliberately increase their costs and add to the deficits regularly accumulated by marketing divisions in many cases in order to exact unnecessarily high prices from consumers. That they should persistently do this year after year when, by simplifying their sales activities and reducing prices, they could vastly increase their sales and replace losses with handsome profits, argues a degree of incapacity that is simply inconceivable even among the poor benighted race of oil men. The consistent record of the oil industry over the past twenty years of steadily reducing the price of its products while constantly improving their quality is sufficient commentary. Yet it must not be forgotten that the man who penned the passage above quoted wields a tremendous power of harassment and possible destruction over American industry.

Perusal of the complaint in the pending federal suit against a large number of oil companies, in the preparation of which Mr. Arnold, according to his own account, has done a long and arduous job of master minding, strengthens the belief that with the oil industry it is a case of damned if you do and damned if you don't so far as the Assistant Attorney General is concerned. In one paragraph crude prices are allegedly too high; in another they are represented as too low. The American Petroleum Institute is accused of restraining refinery output in the interest of monoply in spite of the fact that gasoline stocks have become more and more excessive from year to year while gasoline prices have fallen lower and lower. The industry is made responsible for production policies that are laid down and enforced by state regulatory authorities in harmony with the federal government's attitude toward conservation.

But then, as Senator Ashurst said, a politician who is not inconsistent would not be a politician.

High Officials Review BRAZIL'S Drilling Progress

On Completing His Tenth Year As President of Brazil, General Vargas Can Point with Pride to The First Step in the Solution of Brazil's Petroleum Problem. Through the Courtesy of the National Petroleum Council of Brazil The Following Official Report of Drilling Progress is Released Exclusively to World Petroleum.

H. E. Dr. Getulio Vargas, President of Brazil, visiting the drilling site at Labato on October 20th. Left to right, Engineer Nero Passos, General Horta Barbosa, Edgar Clayton and President Vargas. Right, President Vargas wets his hand with petroleum from well B3.

AT THE end of his tenth year as President of Brazil, on November 10th, H. E. Getulio Vargas made several tours within the country to study economic and social conditions. Late in October, before returning from his last trip through northern Brazil, President Vargas paid his first visit to the Lobato oilfield, on the outskirts of Bahia's capital, where Drilling and Exploration Co., Inc., of Los Angeles California, is boring a series of wells for the Brazilian Government.

While there, the President inaugurated an obelisk commemorating the discovery of oil in Brazil (January 23, 1939), at the same time marking the first producing field in the country, and paying tribute to President Vargas' policy in settling the long debated question of petroleum in Brazil. On the previous evening, while addressing a scientific group at the University of Bahia, the Chief of State summed up this policy as follows:

"Right at this time, in your territory, so full of economic peculiarities, endowed with resources and possibilities which epitomize those of all Brazil, one of the most important battles for Brazil's economic emancipation is being waged—that for petroleum. Long drawn efforts, years of fighting, heated arguments, denials and assertions have reached their end here in the favored soil of Bahia. The existence of petroleum no longer admits of doubt. We had to investigate it without delay. But we were faced with new obstacles: the acquisition of costly machinery and the employment of experts in the industry. We at once took care of these matters, one after the other, and already have got as far as seeing petroleum flowing from the first wells drilled."

In making the address at the inauguration of the monument, General Julio Caetano Horta Barbosa, President of the National Petroleum Council, said that President Vargas has been well-advised in taking control of Brazil's petroleum problem, and in creating the National Petroleum Council to act under His Excellency's immediate direction. The results, he pointed out, are evident: Brazilian engineers and operatives, instructed by American professionals, are at work in Lobato day and night, running the most modern equipment in prospecting for oil. In less than a year a total of 8,930 meters (29,234 ft.) have been bored, of which 6,252 meters (20,444 ft.) are in Bahia, where six wells have been completed and three are in progress. The remaining 2,678 meters (8,757 ft.) are in Alagoas, where the first well reached a depth of 2,145 meters (7,014 ft.) and another has been started.

"At this time", announced General Horta Barbosa, "we are systematically enlarging the geological researches, and geophysical prospection has been completed over an area of about 180 sq. km. (112 sq. mi.), to determine as accurately as possible the drilling sites in areas which present conditions favorable for the accumulation of oil."

"Structures recently determined as favorable for such accumulation, in localities where there are undeniable indications of oil, hold promise for the future and justify our confidence."

One of Brazil's first commercial producers with North American pumping equipment: This is Labato well No. B-3.

Right abo storage tan belonging to t Conselho Nacio de Petroleo the Labato reg for the storage the first commerci produced oil in Bra Note the C.N.P. insig on the side of the ta indicating its owners by the National Counc

General Horta Barbosa was here referring to the district of Candeias, about 45 km. (28 miles) by railway northwest of Salvador, the capital of Bahia, and lying about six kilometers (3½ miles) from the shore of the Bay. It is within that part of the Reconcavo region which, after the discovery of oil at Lobato, was declared a national reserve.

General Horta Barbosa further stated that wells B-3 and B-4 are in production. Although the quantity was less than the most sanguine expectations had hoped for, yet it was enough to prove beyond question that there is an appreciable amount of oil in the national territory. These two wells, with the aid of pumps, are producing an average of 540 liters per hour (69 bbl. per day) of oil with a paraffin base, which is sufficient to supply the needs of drilling operations under way in the locality.

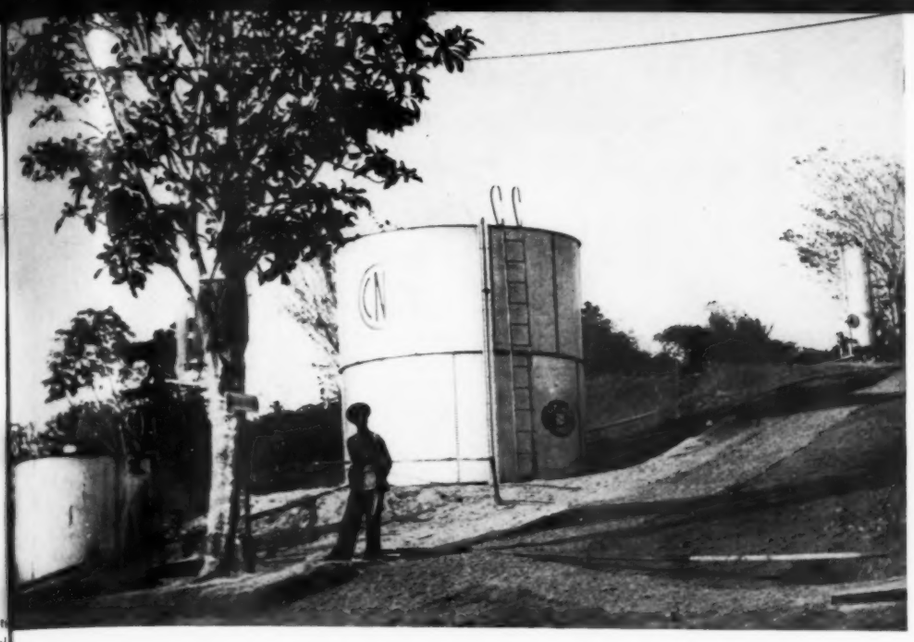
With the three new drilling outfits purchased last summer from the United States, nine wells have been spudded in at and near Lobato within the last ten months. The cable tool rig of 5,000 ft. capacity, manufactured by National Supply Co., which began operations on the 25th of October, last year, at Penha, on Point Itapagipe, is still in use there. This is known as well B-1. Two of the rotary rigs bought from Oil Well Supply Co., have been employed in drilling the rest of the wells. A short distance from B-1, farther north on the Point, well B-8 is in progress.

Well B-5, at Massaranduba, which is south of Point Itapagipe, on a small indentation of the Bay of Todos os Santos, has proved to be dry. South of B-5, and within the city of Salvador, is well B-2, where drilling was terminated toward the end of last March, at a depth of about 5,773 ft. No positive indications of petroleum were found up to that point, but the geological column supplied information useful in revising previous deductions about the local formation.

Across the waters of this small arm of the Bay, opposite the tip of Point Itapagipe, is Lobato, which is on the railway line, about four kilometers (2½ miles) north of Salvador. Here a string of six wells has been put down very close together, parallel to the fault demarking the crystalline rocks from the cretaceous sedimentary formations along the shore.

At the southern end of the string is well B-7, which is dry. About 300 ft. north is B-4, which, with B-3, another 300 ft. farther north, is, as already noted, in production. Well B-3, which was begun in November 1939, and finished in a little over a month, at a depth of 1,287 ft. was drilled in strata which have an average inclination of 45 deg., and consist chiefly of broken conglomerate and slickensided shales with streaks of sandstone. After 1,247 ft., oil sand was reached.

Well B-4 was drilled in a similar length of time, from February to March 1940. Two oil-



bearing strata were met in this case, one similar to that of B-3, consisting of petroliferous sandstone with heavy black oil, between 1,244 ft. and 1,258 ft., and the other, composed of coarse sandstone interlaminated with shales and conglomerates, from 1,574 ft. to 1,672 ft. This latter stratum, which is sharply inclined, is the more productive, being saturated with a light, volatile oil.

Just north of B-3, well B-9 is now in progress. B-9 is close to No. 163, the Lobato oil strike which led to the exploration of this field, and which is the center of the 60 km. (37 mile) radius of reserve area.

Since 1937 the Federal Government's Service for the Development of Mineral Production, led by the surface indications of oil at Lobato, as well as by the thick sedimentary beds of the district, began to explore for oil in the Reconcavo of Bahia. The climax of this research was well No. 163, which was begun in July 1938. Six months later, oil was struck at about 702 ft., after the drill had penetrated sandstone, shale, and limestone in succession. Bore-holes drilled previous to this, along the coast in the southern part of the country and in the Amazon Basin, had provided only slight traces of oil and a little natural gas.

North of this historic well is the last of the Lobato string, B-6, which is dry.

So far the location of the Bahia test wells has followed roughly the curve of the shore in the neighborhood of the capital, from Ponta Itapagipe to Lobato. This work has been carried out under the direction of Engineer Edgar Clayton, of Drilling and Exploration Co., Inc., who is also in charge of the drilling farther north, in the state of Alagoas.

At Ponta Verde, a short distance east of Maceió, port and capital of Alagoas, the rotary equipment of Oil Well Supply Co. which began operations at the end of October 1939, has completed well Al-1. It finished at 7,033 ft. The strata, which have a dip of five to 20 deg., are of the Series of Alagoas, the surface of which has provided specimens of fossils of the Lower Eocene period. This well has provided the best core yet obtained, with many strata saturated with oil. In interviews to the press in Rio de Janeiro, during April 1940, General Horta Barbosa stated that this boring, at about 4,500 ft., showed a bed of oil-bearing sandstone which, at the first application of the production test, yielded 15 bbl. of oil and 253 cu. meters. of gas per twenty-four hours.

A second well, Al-2, is now under way at Ponta Verde, which according to the last report has attained a depth of about 1,747 feet.

The geophysical prospection which General Horta Barbosa said has been carried out over 180 sq. km., was done in Alagoas. Last spring the National Petroleum Council awarded the contract for this work, to be done in areas already under exploration in the states of Alagoas and Bahia, to the United Geophysical Company of Texas. In March, 22 American technicians left New York and New Orleans for Brazil. Superintendent and Chief, respectively, of the Brazil project are Engineers Denning and Lister. The seismographic reflection method is being used.

During June, Mr. Herbert Hoover, Jr. President of the United Geophysical Co., visited Alagoas to inspect operations, and in July also went to Bahia, where arrangements were made with General Horta Barbosa about the studies to be carried out later in that state. The geophysical crews have not yet moved on to Bahia, however.

Concurrently with the geophysical prospection, geological researches are being made in the same areas, with the object of aiding interpretation of the results. This program is being effected by outstanding Brazilian geologists. The National Petroleum Council proposes to obtain detailed maps of the areas surrounding the bore-holes in Alagoas and Bahia.

Earlier in the tour which took President Vargas to the Bahia oilfield, His Excellency visited Manaos, capital of Amazonas, where he announced in a speech his intention of calling a conference of Amazon countries. Then he continued to the remote Madeira-Mamoré railway terminal of Porto Velho, in the Upper Amazon region. There he gave a press interview which has awakened keen interest in South America. He stated:

"I have not come to the Amazon region with the outlook of a tourist, who finds here so many reasons for astonishment and for carrying away profound impressions. I have come with the purpose of seeing to the practical possibilities of putting into execution a plan for the systematic exploitation of the wealth and the economic development of the great valley."

Later, during the interview, President Vargas explained, "As to the conference of which I spoke in my Manaos speech, I should make clear that in it will participate principally those countries which are adjacent to the Amazon Basin, and which must find an outlet for their products to the Atlantic. These countries are Venezuela, Colombia, Peru, and Bolivia.

"The United States may be invited, considering its interests as a great consuming market. The subjects to be dealt with seem to me to be of the greatest importance: trade, interchange, navigation, transport, customs tariffs, and others. We should arrive at an agreement which will practically assure expansion of our activities under conditions of the most ample solidarity."

One of the yet unsolved problems of the type mentioned by President Vargas is the marketing of oil from the fields in eastern Peru, via the Amazon system. This waterway is also the logical outlet for the product of Brazil's Acré Territory, where present prospecting leads to the hope of an eventual oilfield. So possibly the subject of petroleum marketing will be one of those which find their way to the conference table, when this convention is called.

Authoritative Work on Geology of BRAZIL

Special Edition Written in Portuguese by Outstanding Brazilian Geologists Covers Petroleum Geology in Comprehensive Manner.

GEOLOGIA DO BRASIL, the first comprehensive work on this subject by Brazilians, was published recently in Rio de Janeiro. The authors are two of Brazil's outstanding geologists, Dr. Avelino Ignacio de Oliveira and Dr. Othon Henry Leonardos. Both are mining and civil engineers. Dr. Avelino de Oliveira was formerly director of the Service for Development of Mineral Production, but

(Continued on page 64)

Petroleum Plants A Main Objective Of British AIR ATTACKS

As THE titanic struggle in Europe is demonstrating, warfare today is not merely a contest of men and guns. To a far greater extent it is a test of economic strength in which each side endeavors to cripple the industrial resources of the other and to prevent it from receiving reenforcements of supplies from outside its own borders.

During the past six months especially offensive operations have been transferred principally to the air and the primary objective has been to put out of action the manufacturing establishments, transportation lines and storage plants on which the continued functioning of the war machines depends.

The aggressive campaign of the British air force in these past months has aroused the admiration of the world, has won acknowledgement for the fighting quality of the R.A.F. from its antagonists and has given the war an entirely new complexion. Following a carefully laid out plan British bombers have carried the attack to every part of Germany and to Italian industrial centres. In Germany the air raids have been directed primarily against munitions works and power plants, railway terminals and junction points, oil refineries and storage tanks. These have been made the objects of repeated assaults. It is stated, for example, that the railway junction at Hamm which is a nerve centre of the transportation system of western Germany has been raided no less than sixty times.

German airplanes meanwhile are scourging Britain with daily and nightly raids. Instead of being confined to specific objectives such as are being pursued by the British, however, these attacks appeared to be directed to the wholesale destruction of towns and cities for the dual purpose of shattering the productive power of British industry and breaking down the morale of the people. Neither of these ends has been attained as yet.

© International News Photos

British oil storage on the Thames being bombed by German raiders: The R.A.F. has been more consistent in bombing Germany's oil industry than have the Germans in aiming at British refineries.

In both these campaigns petroleum occupies a prominent place. In the operations of the Royal Air Force in fact oil refineries and storage depots seem to have been placed at the very top of the list of objectives to be attacked through repeated raids. The strategy involved is obvious since Germany is unable to obtain petroleum products from overseas but must depend upon its own limited production from wells and through synthetic processes plus such quantities as can be imported from Roumania and the Soviet Union neither of which is an adequate source of supply. By putting German refineries and synthetic oil plants out of operation therefore British bombers seek to weaken the German war machine at one of its vital points.

The full extent of the damage caused by these air attacks naturally cannot be determined by the raiders themselves who can report when they have made hits resulting in fires and explosions but can only surmise from the violence of these manifestations whether plants are injured beyond possibility of immediate repair. The censorship imposed by German authorities prevents information on the subject from leaving the country. Certain reports from other sources, however, appear to confirm the claim that heavy damage has been inflicted on refineries in and about Hamburg, in the Rhineland, in the neighborhoods of Berlin and Hanover, to the great Politz, Stettin and Leuna works and in the districts around Leipzig and as far south as the vicinity of Vienna. Some of the plants in several of these areas are declared to have been put out of commission entirely while others are said to have suffered injuries which have forced them to curtail or suspend activities for the time being.

A few weeks ago the British Ministry of Information published maps showing points in Germany which had been subjected to bombing attack up to the end of September. From these maps the one on the opposite page has been redrawn. To show with greater clarity the extent of the campaign against petroleum objectives other points of attack such as railways, power plants and munitions factories shown in the originals have been omitted.

The vigor of the air siege directed to weakening Germany's oil resources is indicated by the number of important refineries and oil reservoirs that have been subjected to bombing especially when it is remembered that many of these have been the object of repeated attacks.

The British claim as to the effectiveness of their aerial campaign against Germany's oil supply was summarized by Minister of Economic Warfare Dalton some weeks ago in the statement that 90 percent of Germany's synthetic oil capacity had been subjected to the attentions of British bombers and was in varying stages of disintegration and that over

R.A.F. Attacks on German Petroleum Objectives

While not exact, number of bomb symbols indicate relative frequency and severity of raids.

80 percent of the refinery capacity for treating crude petroleum either had been put out of action or was operating at reduced efficiency. Since then new and destructive raids have been launched against Hamburg, Hanover, Magdeburg and Cologne and upon the synthetic plants at Leuna and Stettin.

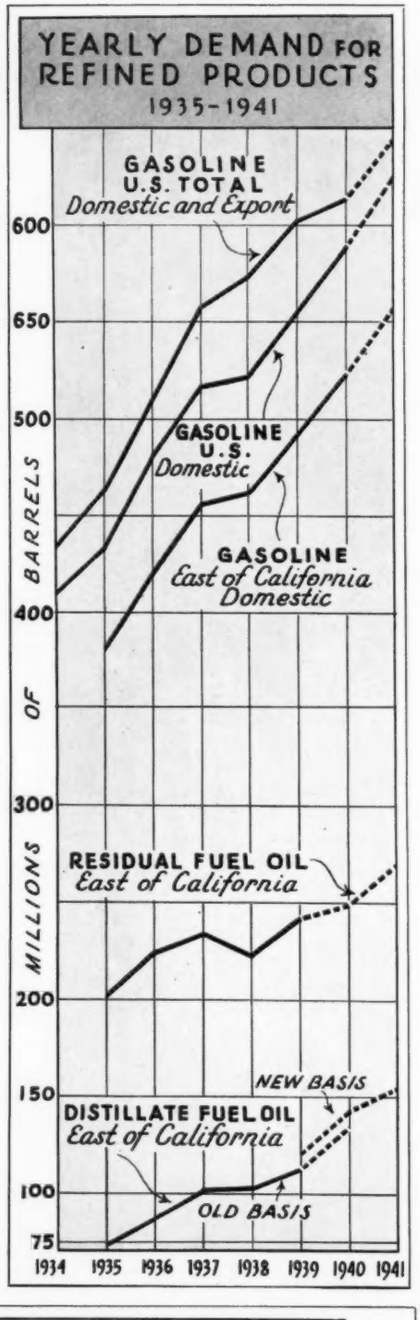
In the early stages of the German air assault on Britain bombing attacks were directed toward oil storage depots along the Thames and there was a report of a raid on a refinery in Wales but details as to the effect of these assaults were lacking. Since Britain's requirements of petroleum products are largely supplied by ocean borne imports the possibilities of seriously hampering the movement of oil supplies by air attacks are limited and the German high command has relied upon submarine attacks on shipping rather than on air raids for curtailing British oil supplies.

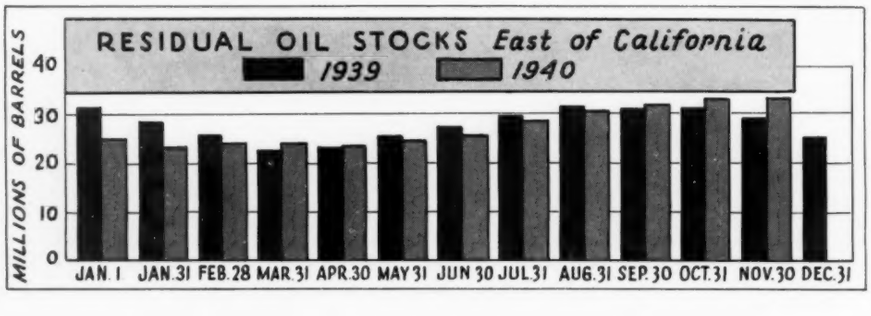
Rise in Fuel Oil Stocks Removes Need for High Winter GASOLINE OUTPUT

Excessive Crude Production Looms as Danger Spot in Present Oil Situation - Expected Rise in Industrial Activity Promises Moderate Increase in Gasoline Consumption in 1941.

Beginning early in 1940 World Petroleum has published a number of articles emphasizing the importance of maintaining a better balance between fuel oil and gasoline stocks than has existed heretofore. These articles have dealt with the subject from the viewpoint of the economic burden imposed by excessive gasoline stocks and from the technical angle of refinery operation have shown the feasibility of increasing the ratio of distillate to gasoline in order to provide more adequate fuel oil supplies at the beginning of the season of heavy consumption.

These articles have brought a widespread response and leading refining companies have increased their fuel oil output during the past season and have provided additional storage to handle it. As a consequence, as pointed out in the following survey of the situation, stocks of heating oils are substantially larger than at corresponding dates in previous years and the necessity of continuing an unseasonably large gasoline output during the coming winter is removed. The danger spot in the present situation is the over-production of crude which remains as a problem for the industry to deal with.




RESIDUAL OIL STOCKS East of California
1939
1940
MILLIONS OF BARRELS
40
30
20
10
0
JAN. 1 JAN. 31 FEB. 28 MAR. 31 APR. 30 MAY 31 JUN 30 JUL. 31 AUG. 31 SEP. 30 OCT. 31 NOV. 30 DEC. 31

AT ABOUT this time each year when the summer's gasoline sales have been added up, initial deliveries have been made to consumers of domestic heating oils, and programs and budgets for the next year are under consideration, it is the general custom in the oil business to consult the soothsaying forecaster in the perennial hope of finding out what the next year has in store in the way of increased business. This is a genial and diverting recreation, in keeping with the holiday spirit, and creates for the oracles an auspicious occasion in that it is about the only time in the year when they are permitted to speak in other than a hushed voice, or, in fact, are permitted out of the confines of the back office where they are quartered. Knowing that their opportunity to be heard will be brief, they seize upon it and shout their views, some with an air of authority and others with a spirit of sheer recklessness, but all in such a loud voice that the bedlam which ensues drowns out whatever prudent opinions may have been uttered. After they have retired again to their dark corners to manipulate their calculating machines, push their slide rules, or gaze into their crystals for another year, the industry proceeds on its way very much as though nothing had happened.

This year, strangly enough, the voices of these seers are not so loud; there is a trace of hesitation in their utterances; their patron genii who, in other years, have supplied them with their prophecies presumably could not be materialized and so the industry must enter the new year through a haze of uncertainty.

With such a state of affairs, it is understandable that there are many conflicting opinions as to demand for petroleum products during 1941. In general, it seems that the estimates hinge largely upon the individual forecaster's appraisal of the impetus that will be given to consumption by the defense program. With such conflicting opinions, it, doubtless, will be the policy of the industry to pursue a practical course and wait until the demand develops before going too far in preparing for it. Refiners who made gasoline a year ago in anticipation of an enormous export business are showing considerably more caution in preparing for an increase in consumption of automotive gasoline which may result from the program of rearmament.

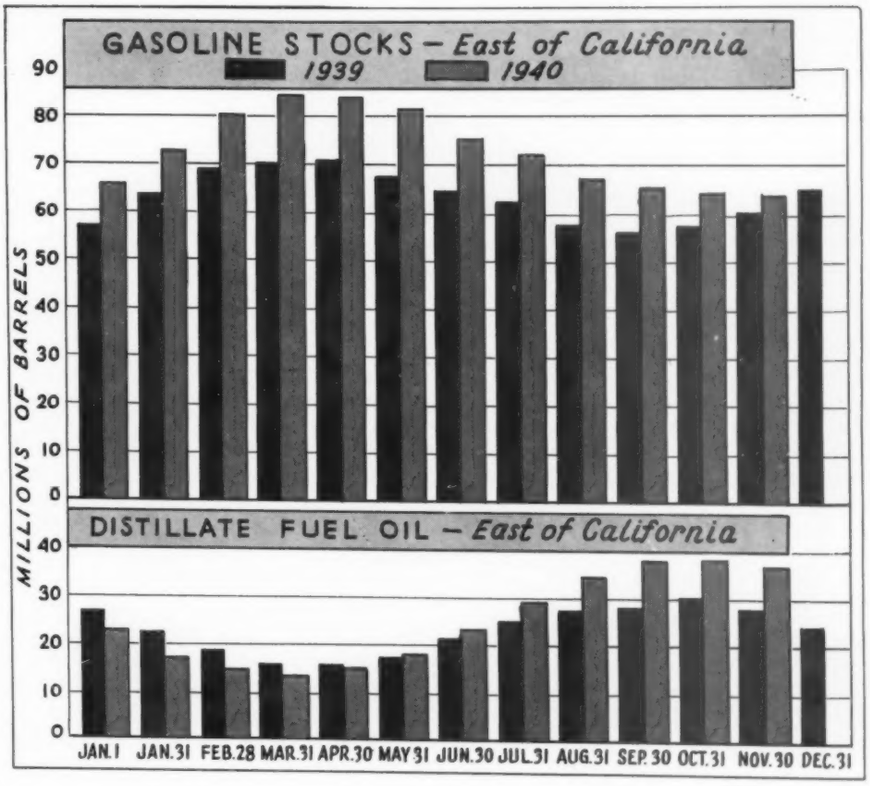
All in all, however, it does appear that the number of motor vehicles in use in 1941 will be greater than in 1940 and with factory employment at a high level the consumption per vehicle is likely to show another increase. There is little doubt that there will be a very sharp increase in the demand for aviation gasoline aside from the stock pile purchases that may be made by the Defense Commission. And so it hardly seems likely that the increase in domestic demand for gasoline will be less than six percent. This, however, is likely to be partly offset by a further loss of

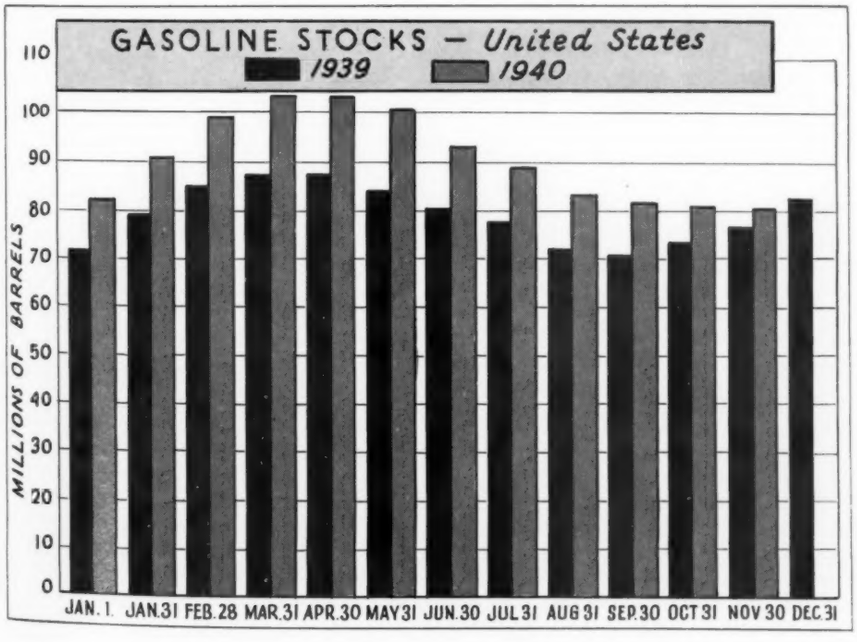
export business, but nevertheless might carry the total demand for motor fuel to an all time high on the order of 645,000,000 bbl.

While the petroleum industry has grown and thrived on a constantly increasing demand for its products, perennial increases alone will not make it prosperous. In any event, such increase in demand as is predicted is as yet an intangible benefit. On the other hand, there are today two very depressing features in the industry's outlook. These are: (1) the surplus of gasoline which has been carried over and for which there seems to be very little hope of liquidation at any time in the near future, and (2) excessive production of crude oil.

At November 30th, gasoline stocks were approximately 4,500,000 bbl. greater than on November 30, 1939, but this is not as bad as it appears at first glance because this increase can be accounted for largely by the increase in stocks of aviation gasoline for which there is little doubt there will be an accelerated demand over the next year. If the Defense Commission's plans are realized, a substantial part of this, together with 100 octane aviation gasoline to be made during 1941, will be taken out of circulation by their purchases. Stocks of all gasoline (excluding natural) at March 31, 1941 may conceivably be as high as at March 31, 1940, but it must be remembered that the March 31, 1940, stocks resulted from two causes: (1) the necessity of running crude oil to meet the distillate fuel oil demand, and (2) the expectation of a sharp increase in the export business. Today neither of these considerations exist. Distillate fuel oil stocks, particularly along the Atlantic Coast and Gulf Coast, are adequate for even a severe winter's requirements and refiners are taking a more cautious view with respect to the increase in domestic demand.

At the present time the runs to stills are excessive and have been for several months, but it is reasonably safe to say that stocks of all gasoline, aviation and automobile, at the end of the coming winter will not exceed the 103,700,000 bbl., that were in storage on April 1st of this year and that such a figure represents some improvement in stocks of automobile gasoline due to the increase in stocks of aviation gasoline.





Aviation gasoline, while constituting less than two percent of the total demand for gasoline, nevertheless holds the center of interest in the gasoline market. Due to the revisions in classifications and specifications the statistics for this product are not as informative as could be desired. It is doubtful that the figures which have been published are a comparable sequence. It is difficult if not impossible to make a satisfactory statistical analysis of the supply and demand position of this product.

A question frequently asked is whether the present capacity for making aviation gasoline in the United States is adequate for the demand that may be expected in the future. While it is indeed difficult to make a quantitative statement, due largely to the lack of competent opinion as to what the demand will be, it does seem that the present day capacity of plants for the manufacture of aviation gasoline blending components is sufficient to permit the manufacture of any demand for aviation gasoline including the 100 octane grade that reasonably can be foreseen over the coming year. New plants for the manufacture of blending components are under construction and others are under consideration and as these new facilities are put in operation during 1941, it appears likely that the supply will be of such an amount that there will be a continuation of the present practice of using small quantities of these materials for blending into premium gasolines.

stocks are more than adequate for any demand which reasonably can be foreseen. Stocks at November 30th east of California will be on the order of 37,000,000 bbl. as compared to 28,000,000 bbl. a year previous. Offsetting this back-log is the fact that it is not desirable to run these stocks as low as was necessary in March, 1940. Had the present stocks existed in the fall of 1939, much more stable conditions would have existed in the heating oil market during the succeeding months; and the excessively high runs to stills during the first quarter of 1940 could have been avoided.

The demand for residual fuel oil over the year 1941 doubtless will show a substantial increase over 1940, perhaps as much as eight to ten percent. However, it is not believed that this increase will occur early in the year, but rather that the demand will rise when the defense program gets into full swing later in the year. The principal users of this product are vessels, railroads, manufacturing industries, heating plants and gas and electric plants. The railroads, whose consumption amounts to about 19 percent of the total demand, probably will consume larger quantities during 1941 than in 1940. Industries that use 20 percent of the total will likewise increase their consumption. It is extremely doubtful that there will be any increase in the amount delivered to ships' bunkers which constitute about 21 percent of the demand, and there is no reason to believe that there will be any increase in the amount used for heating as there are very few new heating installations using residual fuel oil. The quantity consumed by the Army, Navy and Coast Guard, amounting to about four percent of the total demand, doubtless will show a marked increase, particularly during the summer of 1941.

On the foregoing premises, it is concluded that while the demand during the entire year will amount to eight to ten percent more than the 1940 demand, the demand for the six winter months of 1940-41 will show little, if any, increase over the corresponding period of 1939-40 and consequently the stocks of residual fuel oil east of California, amounting to 32,000,000 bbl., as compared to 29,200,000 bbl. at November 30, 1939, are entirely adequate. In any event, additional supplies that may be required will be found in the increased imports when the new 1941 reciprocal quotas become available.

While, if sufficient stimulants are used, a mild feeling of optimism can be worked up for the refined oil position, it is difficult to find anything but discouragement in the crude oil production picture. The amount of new money that has been poured into new development in the past four or five years as the result of money being so easy to obtain for this purpose, is exerting an unfortunate pressure which is revealed in the form of protests against constantly reduced allowables. While it must have been known at the time these expenditures were being made that drilling on such a large scale was bound to have the ultimate effect of lengthening pay-out periods unduly and reducing the attractiveness of such investments, a fairly long period of time is required for such an effect to react on the cause as is evidenced by the fact that the new wells drilled in 1940 are about 15 percent higher than in 1939. Some reduction in this rate, however, can now be expected. The other uses to which money now can be put may be a blessing in disguise to the producing business in that it will retard the flow of new money into oilfield development.

The problem of meeting his financial commitments from reduced allowables is a most pressing one for the producer and until it is solved, it is difficult to see how any permanent improvement can be made in the crude oil economy. It is not to be assumed that the heavy expenditures which have been made were unnecessary. It is true that in certain fields, particularly East Texas, there is no justification for the amount of money that has been invested in development, but aside from such exceptions the drilling that has been done is justified by the improvement in production practices which have been made possible by producing a larger number of wells at lower rates, thereby increasing the ultimate recovery and conserving the underground reserves of this valuable resource. In other words, adherence to true conservation principles in the production of crude oil requires a much larger capital investment than was needed before these principles and practices were adopted. The cost of this money is a fixed charge which must be met regardless of the size of the income and borrowed money must be repaid in a fixed period of time that generally is less than the pay-out period of the well. Such are the conditions that prompt every producer to seek higher daily allowances for his wells.

If an equitable formula for allocating the nation's requirements to the individual pools could be devised and accepted there is little doubt that every producer would receive an allowance that would enable him to pay his costs, meet his reasonable obligations and realize a satisfactory profit. However, lack of production control in some states, the insistence of other states on the use of its proration orders of the principle of "market demand within the limits of physical waste prevention" and the practice on the part of some purchasers of crude oil of taking substantial portions of their requirements from a single pool or group of pools, all operate to defeat rational proration.

While month by month conditions become more acute there is one ray of hope—a ray that in the oil industry in the past has always presaged the light of successful accomplishment. It is this: The seriousness of the situation is recognized and is receiving the study and consideration of some of the most competent men in the petroleum industry.

War Cuts Petroleum EXPORTS of United States

Decline of 22 Percent in Shipments During First Year of War —Decrease Due Mainly to Inability to Reach Continental European Markets — Further Drop Probable if War Continues.

EFFECT of a year of war upon United States exports of petroleum is shown by a compilation prepared by the Metals and Minerals Division of the Bureau of Foreign and Domestic Commerce in Washington. The statistics cover the two twelve month periods, Sept. 1, 1938-Aug. 31, 1939, and Sept. 1, 1939-Aug. 31, 1940; that is, the first full year of war in Europe compared with the year immediately preceding.

Table I, drawn from the monthly reports of the Department of Commerce, shows in brief compass the changes that have taken place in each of the principal products mentioned. As was to be expected from the shutting off of communication with numerous countries that in normal times are important purchasers of American oil products the fall in the volume of exports has been severe, ranging from 15 to nearly 60 percent for various products and averaging approximately 22 percent for the entire list.

Of the exports that have shown a decline following the commencement of the war the smallest proportionate decrease was in crude oil. It amounted roundly to 11,000,000 bbl. or 15.5 percent. On the other hand natural gasoline and the light products of refining were among the heaviest sufferers with a drop of 58 percent or more than one half. Before the war a large trade in natural gasoline had been built up with the United Kingdom, Italy and Germany. Shipments to the two latter were cut off by the blockade while in the case

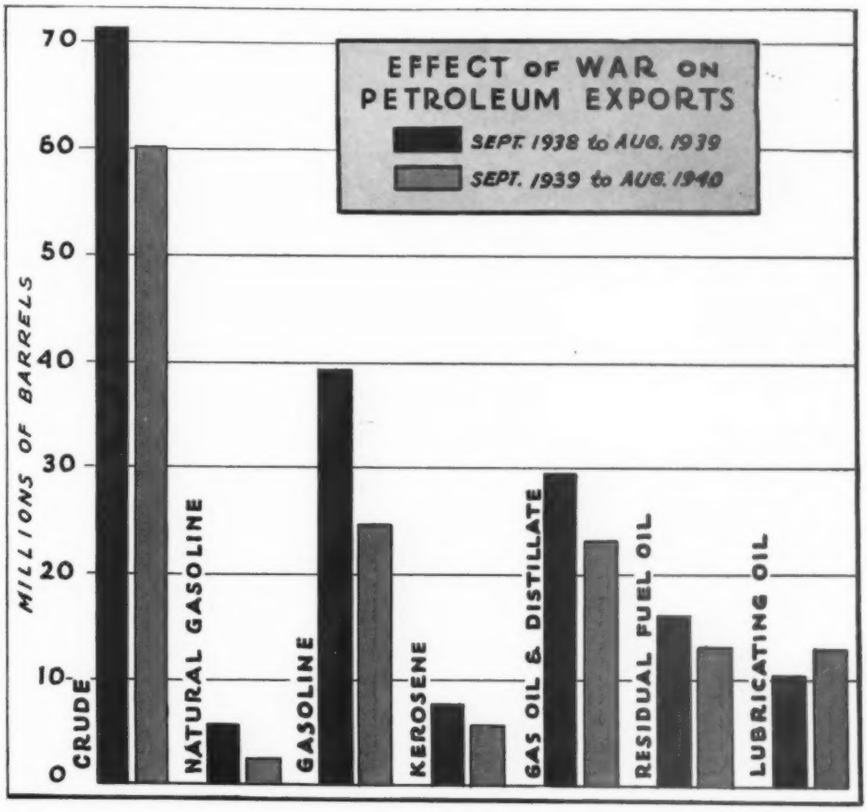
TABLE I

U. S. Petroleum Exports

(Thousands of Bbl.)

	Sept. 1938 Aug. 1939	Sept. 1939 Aug. 1940	Dec. or Inc. Bbl.	Dec. or Inc. %
Crude	71,121	60,041	−11,080	−15.5
Natural Gasoline	5,217	2,183	− 3,034	−58
Aviation Gasoline	2,919*	3,207	+ 288*	+9.8*
Other Gasoline	37,047	21,236	−15,811	−42
Other light products	1,613	649	− 964	−39.7
Kerosene	7,700	5,401	− 2,299	−29.8
Gas oil and distillate	29,514	22,975	− 6,539	−22
Residual fuel oil	15,892	12,972	+ 2,920	−18
Lubricating oil	10,334	12,591	+ 2,257	+21.8
	181,357	141,255	−40,102	−22

*Not listed separately prior to Jan. 1, 1939.



of Great Britain the pooling of motor fuel at the beginning of the war removed the demand for natural gasoline for blending while the national policy has been to limit purchases outside the country to commodities regarded as indispensable.

Since aviation gasoline was not reported separately in Department of Commerce tabulations prior to January 1, 1939, the figures for exports of that product are not strictly comparable. Taking into account all gasoline, however it appears that the decrease in exports during the first twelve months of war as compared with the year preceding was upward of 15,000,000 bbl. or roundly 40 percent. This trend has run counter to the expectations held not only by oil men but by practically all others conversant with conditions at the start of the war. The assumption was that the extensive use of fighter, bombing and transport planes would call for much greater quantities of high test gasoline than ever had been produced up to that time and that reliance upon motor transport for the movement of men, guns, food and other supplies would demand correspondingly large amounts of ordinary gasoline. Here again the blockade has shut off most of the continent of Europe from imports by sea. Even before this barrier existed to its present extent, however, sales of American motor fuel had fallen off as it was found that the saving in consumption in countries where the private use of gasoline was either severely rationed or wholly forbidden more than offset the added demand for military use.

Exports of distillate and residual fuel oils

TABLE II

Petroleum Exports to Principal Markets
Sept. 1938 — Aug. 1939 and Sept. 1939 — Aug. 1940

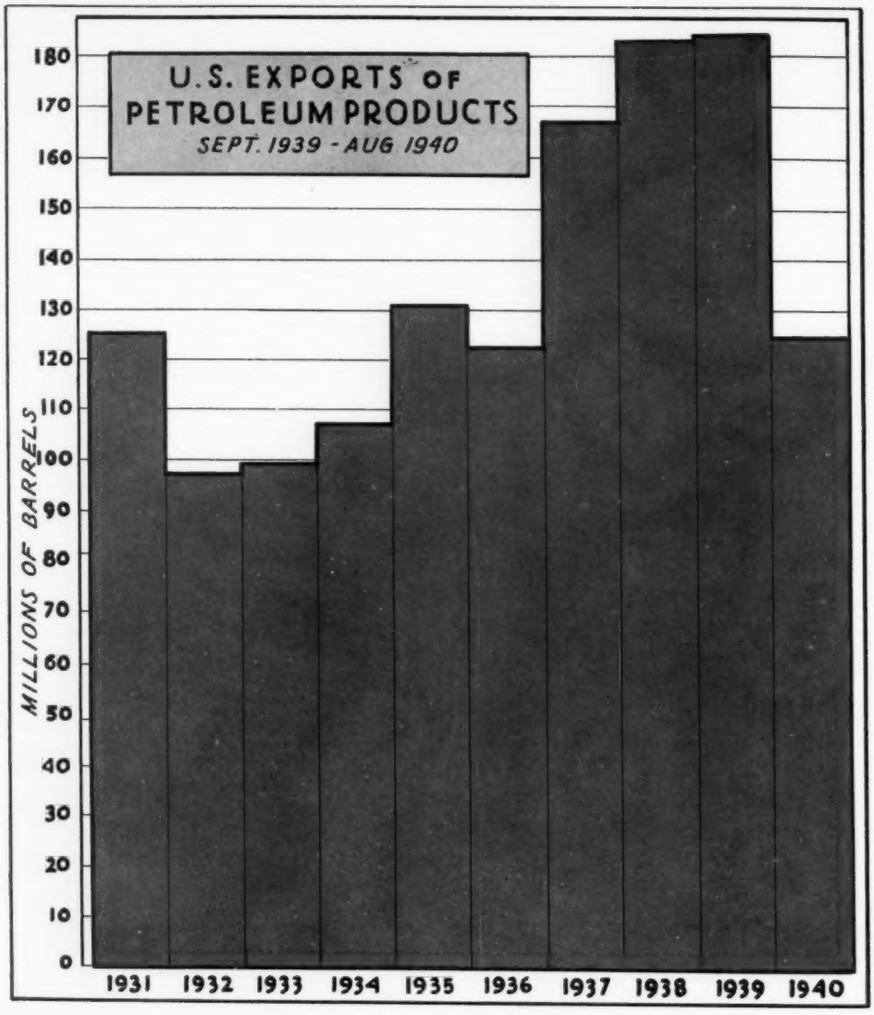
(Quantities in 1,000 Barrels)

November 15, 1940

Country	Crude Petroleum (1)	Crude Petroleum (2)	Natural Gasoline (1)	Natural Gasoline (2)	Aviation Gasoline* (1)	Aviation Gasoline* (2)	Other Gasoline (1)	Other Gasoline (2)	Naphtha, Solvents and Other Finished Light Products (1)	Naphtha, Solvents and Other Finished Light Products (2)	Kerosene (1)	Kerosene (2)	Gas Oil & Distillate Fuel Oil (1)	Gas Oil & Distillate Fuel Oil (2)	Residual Fuel Oil (1)	Residual Fuel Oil (2)	All Lubricating Oils (1)	All Lubricating Oils (2)
Belgium	267	85	23	....	8	....	1,371	354	....	....	19	12	1,066	350	66	10	812	523
Denmark	246	22	....	....	12	31	622	408	....	....	465	154	480	277	252	128	197	314
Finland	106	....	....	....	9	53	169	203	....	....	79	43	76	48	....	....	22	28
France	16,725	9,452	841	239	528	635	2,353	99	61	....	1	....	133	....	7	....	482	404
Germany	905	....	....	....	24	....	1,973	....	....	....	17	....	5,517	....	361	....	1,543	....
Ireland	....	....	....	....	....	....	256	79	....	....	26	63	24	29	....	....	2	12
Italy	6,612	2,611	101	32	212	2	90	55	....	....	13	1	25	298	1,848	373	327	578
Netherlands	412	....	105	....	67	....	138	668	98	....	1,019	509	2,845	734	740	....	232	18
Norway	358	....	81	....	11	2	1,691	374	4	10	130	142	369	710	84	....	39	110
Portugal	....	548	....	....	1	7	381	77	72	209	202	51	169	201	....	25	43	101
Russia (U. S. S. R.)	....	....	96	....	....	....	226	1,109	....	....	....	....	....	....	....	....	....	....
Spain	....	....	....	....	34	....	1,982	1,696	....	....	....	100	567	1,052	592	1,514	162	513
Sweden	374	130	....	....	22	70	2,590	1,222	17	69	387	219	622	892	394	132	219	213
Switzerland	....	....	....	....	5	25	671	66	....	....	50	8	352	20	61	....	5	70
United Kingdom	406	682	1,146	309	473	377	9,109	3,256	100	120	1,550	794	4,868	3,715	440	297	2,697	3,212
Canada	25,606	29,266	663	1,014	32	202	1,931	1,376	74	105	236	235	589	703	338	1,452	469	532
Neth. West Indies	....	....	1,738	420	548	742	2,182	886	824	212	806	247	3,724	3,712	....	....	15	26
China	89	....	....	....	....	1	102	290	1	1	166	409	311	248	200	22	16	139
Japan	14,163	13,683	195	13	82	315	598	934	3	6	20	127	5,372	5,851	3,880	2,828	370	552
Kwantung	1,109	609	....	....	25	70	701	920	....	....	290	71	39	96	....	....	52	46
Philippine Islands	....	79	1	....	54	69	987	1,176	32	1	482	563	527	552	719	749	107	154
Australia	....	2	....	....	5	1	1,142	927	9	39	91	157	24	53	....	7	464	742
New Zealand	....	....	94	....	80	1	429	3	2	6	35	8	89	24	108	6	88	153
Union of South Africa	....	....	....	....	12	28	247	40	8	20	16	29	8	8	....	....	128	308
Canary Islands	....	....	....	....	....	....	....	....	....	4	....	....	33	75	322	72	10	5
All other countries	4,343	2,872	133	156	674	376	5,106	5,018	308	47	1,600	1,459	1,685	3,325	5,480	5,357	1,733	3,638
TOTAL	71,121	60,041	5,217	2,183	2,919	3,207	37,047	21,236	1,613	649	7,700	5,401	29,514	22,975	15,892	12,972	10,334	12,591

(1) September 1938 through August 1939.
(2) September 1939 through August 1940.
*Data for aviation gasoline not collected as such prior to January 1939—formerly included with motor gasoline, therefore, Column (1) includes figures from September to December 1938.

Compiled in the Metals and Minerals Division, Bureau of Foreign and Domestic Commerce.



suffered relatively moderate declines in the reductions of 22 and 18 percent respectively. These two classes of fuel are important items of petroleum export. Combined they equal in volume the shipments of gasoline in normal times and their shrinkage has been proportionately less than that of gasoline under war conditions.

In lubricants the trend controlling in other petroleum exports has been reversed and shipments actually have increased since the start of the war. This is shown in the table by the gain of nearly 22 percent for the year following Sept. 1, 1939. A similar relative increase is shown in exports of lubricating greases which rose from 45,000,000 to 57,000,000 lbs. or roundly 25 percent in the same period.

Table II shows the distribution of exports by products among the principal countries of destination during the first year of war and the year preceding. This tabulation is an interesting supplement to Table I as it reveals exactly where the losses in export sales have taken place and where, in a relatively few areas, gains have occurred.

While pre-war exports of crude were large in volume, ranging from 60,000,000 to 72,000,000 bbl. yearly, nearly 90 percent of these shipments went to some half dozen countries. Among these were Canada, Japan, France, Italy and Germany. Shipments to Germany ceased at the very outbreak of hostilities. Those to Denmark, Norway, Netherlands, Belgium and France ended with the German occupation of those countries. Those to Italy terminated, of course, with the entry of that country into the war.

Thus, through participation in the war or by the operation of the blockade, roughly half the export market for the crude oil of the United States was cut off. That the actual decline in exports was only about 15 percent was due to two factors. The most important was that for some six to eight months after the start of the war several of these European countries still were able to import and in fact continued to buy crude from the United States, though in reduced volume. A minor factor was that a few countries, of which Canada was the most important, actually increased their purchases from the United States. In view of the fact that during the year Sept. 1939-Aug. 1940 upward of 10,000,000 bbl. of crude went to countries whose markets are now closed to United States exports, a further decrease in crude exports during the current year seems probable.

Somewhat similar conditions apply to exports of gasoline although shipments of this product are spread among a greater number of countries than is the case with crude. Prior to the war the most important single customer for United States gasoline was the United Kingdom but in the twelve months following its commencement British purchases were only a little more than one-third of their former volume. Countries of continental Europe from which the United States is now isolated took nearly 10,000,000 bbl. of gasoline in the year before the war and imported nearly 3,000,000 bbl. after the war was on. Some further decrease in gasoline exports during the second year of the war therefore seems probable.

The only countries that materially increased their purchases of gasoline from the United States during the year ended Aug. 31 last were the Soviet Union and Japan. There is a possibility of course that exports to both these countries may be seriously curtailed during the coming year.

Before the war the largest purchaser of distillate fuel oil from the United States was Germany while other continental European countries that were important importers were the Netherlands, Belgium and Denmark. Lack of purchases from Germany, Netherlands and Belgium alone accounted for the decline in exports during the twelve months following the start of the war. Gains and losses in exports to other countries fairly well offset each other. Exports to the United Kingdom, which was second only to Germany among European countries as an importer of light fuel oil, fell off over 1,000,000 bbl. following the declaration of war. On the other hand shipments to Spain, Sweden, Canada and Japan increased.

Two countries led all others in imports of American residual fuel oil before the war. These were Japan and Italy which took approximately one-third of all shipments. Exports to both countries have decreased greatly during the past year but shipments to Spain and Canada have increased to nearly a like extent.

Despite loss of the important German market for lubricating oil, exports from the United States increased over 2,000,000 bbl. in the year following the outbreak of war. The gain was due largely to heavier shipments to the United Kingdom, Spain, Canada, Australasia, South Africa and Japan. Accelerated industrial activity in connection with the war effort explains the rise in imports by British Empire countries.

While the war cut a big hole in the export trade of the United States in petroleum products the total volume of shipments was greater than in years as recent as 1936. Detailed examination of export statistics shows that the decrease has been confined almost wholly to countries of continental Europe which are unable to import from overseas either because of their participation in the war or because their ports are under blockade. The shortage of petroleum products is becoming increasingly acute in all these countries. As soon as international highways are opened again a tremendous demand for all these products undoubtedly will make itself felt in order to make up the accumulated defficiency. That demand presumably will be concentrated on refined products in view of the widespread destruction of refining plants in Europe during the course of the war.

Oil Machinery Exports Well Maintained Despite War

WHILE there has been much discussion of the influence of the European war upon the important export trade of the United States in oil machinery and some sweeping statements have been made as to the devastating effect upon this business the first detailed figures as to actual results are now available. Month by month statistics of the U. S. Department of Commerce giving oil machinery exports have been compiled for the twelve month period from Sept. 1, 1939 to August 31, 1940, covering the first full year of war and for the corresponding period immediately preceding, from Sept. 1, 1938 to Aug. 31, 1939. Thus, a comparison is possible between a peacetime year of great activity in drilling and refining operations throughout the world and a subsequent year in which these activities were interfered with by the outbreak of war.

This comparison contains some revelations surprising to those who have been led to believe that the export business of the United States was disastrously depressed or even, as some published statements have made it appear, virtually wiped out by the impact of war. On the contrary, as shown by detailed figures in Tables I and II accompanying, the actual decline in the value of U. S. exports of oil machinery during the first full year following the outbreak of the war was 29 percent as compared with the year immediately preceding.

This, however, does not tell the full story. Exports of drilling machinery during the twelve months Sept. 1938-Aug. 1939 were valued at $19,887,525, while in the following year, with the war under way, they amounted to $18,158,390. This is a decline of only 8.2 percent and it is noteworthy that the value of drilling machinery exports in this year of war disturbance was greater than in any calendar year of the past decade prior to 1937.

Exports of drilling machinery to Europe and most countries of the Near and Far East fell off following the outbreak of the war owing to difficulties of transport and the fact that exploratory work in some of these fields was suspended. Thus, shipments to Netherlands India, Iran, Egypt and Roumania showed a marked decrease. At the same time an increase in activity in other parts of the world led to an enlarged demand which resulted in an expansion of drilling machinery exports to Argentina, Brazil, Mexico, Trinidad, Canada, the Soviet Union, British India and Burma. The Latin American market as a whole took practically the same amount of drilling equipment in the year following the outbreak of the war as in the year preceding.

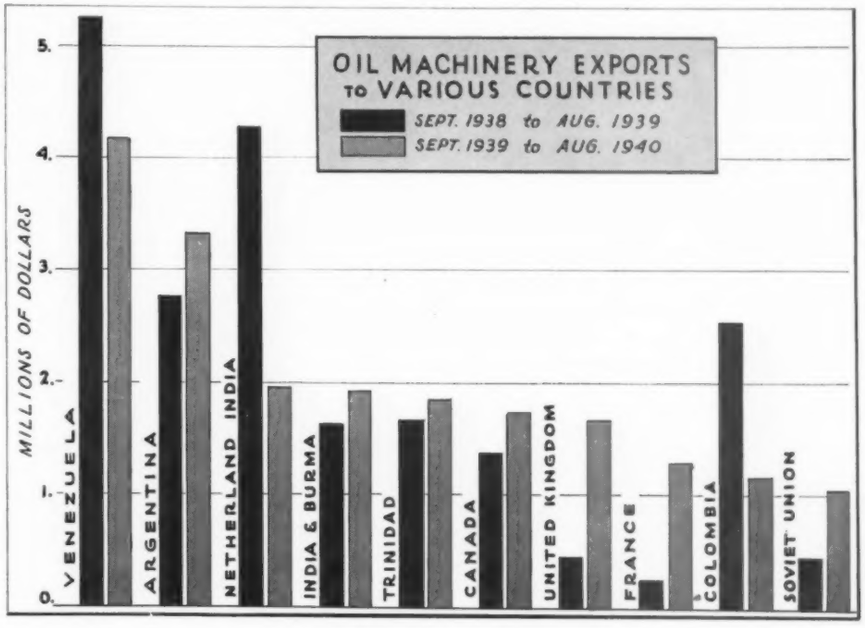


TABLE I

Exports of Oil Machinery from U. S.

Sept. 1, 1938—Aug. 31, 1939

Month 1938	Drilling Machinery	Refining Machinery	Total
Sept.	$1,753,003	$1,312,136	$3,065,139
Oct.	1,327,202	1,654,835	2,982,037
Nov.	1,652,142	1,057,955	2,710,097
Dec.	1,709,766	1,381,295	3,091,061
1939			
Jan.	1,707,582	1,021,543	2,729,125
Feb.	1,637,342	1,687,239	3,324,581
March	1,824,232	2,307,964	4,132,196
April	2,155,217	1,890,995	3,956,212
May	1,487,184	1,695,127	3,182,311
June	1,554,142	1,940,373	3,494,515
July	1,439,628	1,678,508	3,118,136
August	1,640,085	1,719,765	3,359,850
Total	$19,887,525	$19,257,735	$39,145,260

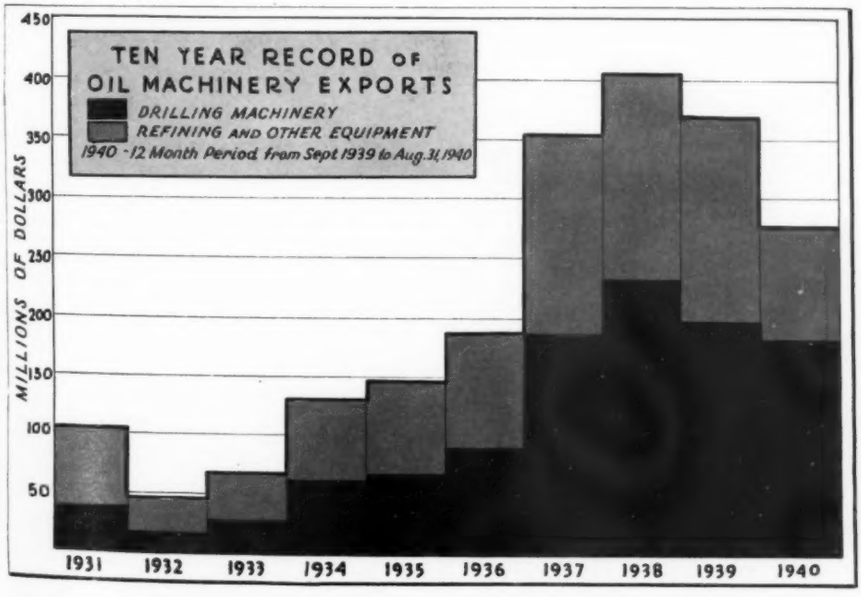


TABLE II

Exports of Oil Machinery from U. S.

Sept. 1, 1939—Aug. 31, 1940

Month 1939	Drilling Machinery	Refining Machinery	Total
Sept.	$1,621,314	$1,041,222	$2,662,536
Oct.	1,712,565	651,022	2,363,587
Nov.	1,259,307	638,828	1,898,135
Dec.	1,788,826	943,026	2,731,852
1940			
Jan.	1,270,422	671,928	1,942,350
Feb.	1,361,470	677,768	2,039,238
March	1,481,208	1,126,005	2,607,213
April	1,509,831	689,193	2,199,024
May	1,504,021	569,554	2,073,575
June	1,275,271	823,461	2,098,732
July	1,596,187	1,143,354	2,739,541
August	1,777,968	410,381	2,188,349
Total	$18,158,390	$9,385,742	$27,544,132

Table III shows the principal countries importing this class of machinery from the United States in each of the two years specified. As the figures indicate increases and decreases have been about equal in number though varying in extent. On the whole it may be said that the war, during its first year, has not seriously diminished the export

(Continued on page 59)

ROAD SYSTEM Falls Short of National Defense Needs

Improvement in Existing Federal and State Highways of U. S. and Addition of New Links Necessary for Rapid Movement of Troops and Supplies — Bridge Replacement Called For — Construction of Access Roads to Camps and Munitions Plants Immediate Task.

Army tanks crossing a weak bridge of a type that will have to be replaced under present plans for a military road system.

ONE of the primary necessities of modern military operations and one that is particularly important to the successful defense of an attacked nation is an adequate system of improved highways. The increasing mechanization of land operations calls for solidly built, hard surfaced roads and strong bridges capable of sustaining big tanks, heavy guns and the long columns of trucks required to move men, armament and supplies from one point to another without delay.

Railway lines are still important in the defense scheme, particularly for long distance movement of supplies, but they cannot be made sufficient alone. Moreover, railway terminals, bridges and junctions are highly vulnerable to aerial attack as recent experience has shown and cannot be repaired as readily as highways.

Officers of the United States army whose task is to deal with transportation have long been aware of the importance of a road system adequate for military needs. Nearly twenty years ago, directly following the first world war, plans were worked out for a system of main connecting highways fairly comprehensive for the conditions of the time. These are shown on the accompanying map which is referred to in military circles as the Pershing map of 1922. In the interval, however, great changes have taken place in the movement and equipment of armies while in the United States chief attention has been paid to the provision of local and through routes for pleasure driving and commercial traffic. Many changes and improvements are needed to bring existing road systems up to date from a strategic viewpoint and some entirely new highways should be constructed to provide direct communication between important points in the defense system and to remove existing traffic bottlenecks in and around the larger cities.

Merritt Parkway, part of the system that connects New York City with important industrial sections of New England. This type of road would be invaluable for military purposes.

One of the strong points in Germany's military organization is the elaborate system of *autobahnen* or strategic highways built during the past seven years of war preparation. These do not compare in scenic attractions or landscape effects with some of the motor parkways that have been constructed around American cities, but they are serviceable, hard surfaced roads running in straight lines, avoiding towns and cities and connecting central points and producing centers with the frontiers. These motor roads have removed a large part of the traffic load from Germany's inadequate railway system and have enabled the military command to move troops, guns and supplies at high speed from any part of the country to any other part where they might be needed.

In the United States the greatest need for additional through routes for the rapid movement of military and other traffic appears to be in the industrial areas and the districts of congested population in the Atlantic seaboard states from New England to Washington. It is in exactly such areas that improved road building requires most time

Above, third army manoeuvers on a two-lane highway in Louisiana demonstrating the inadequacy of this type of road. Right, German state motor highway, part of the system that has facilitated troop and supply movements in that country.

and is most expensive. A plan recently put forward for an arterial highway to handle heavy traffic entering or leaving New York city in the direction of New England contemplates an expenditure of $65,000,000 for this small section alone. Because of the factors of time and expense most of these more elaborate projects probably will be deferred in favor of urgently needed construction that can be completed more promptly.

Rest period during troop manoeuvers in Mississippi. Recent road building has provided a network of improved roads that are a priceless asset in the national preparedness program.

In fact President Roosevelt's statement that public works generally will be subordinated in the 1941-1942 budget to the needs of national defense has been taken to mean that the construction of so-called superhighways is out the window at least until the immediate defense program is completed.

As outlined at present this program falls into two categories in the order of priority as follows: (1) the construction of access roads and streets for Army and Navy reservations and for new and expanding defense industries; (2) the modernization of many substandard portions of existing main highways, so as to bring the "Pershing Map of 1922" of strategic highways up-to date.

The importance of concentrating federal and federal-aid funds on these two projects is being emphasized alike by John M. Carmody, Federal Works Administrator; Thomas H. MacDonald, Public Roads Commissioner and Representative Cartwright of Oklahoma chairman of the House Roads Committee, all in agreement with the War and Navy Departments and the National Defense Advisory Commission.

In an address on methods of adapting the highway system to defense Mr. MacDonald told the Asphalt Conference that these two urgencies warranted the serious attention of the industry and all state highways authorities. They likewise have been outlined to the American Automobile Association by Mr. Carmody and the Association of State Highway Officials by Representative Cartwright.

According to Mr. Carmody the most recent survey of the Public Roads Administration, made in cooperation with the various state

Courtesy U. S. Bureau of Public Roads

Texas road of a type considered ideal by the army. Note the broad shoulders referred to in the accompanying article.

highway departments, shows that 4,000 miles out of 75,000 miles of the strategic highway system, are less than 18 ft. in width and 14,000 miles are deficient in surface strength. In addition, 2,400 bridges fall below the standard strength, and 500 bridges do not meet the 18-ft. standard of width or the 12½-ft. standard of clearance, or are deficient in both respects.

Under normal conditions the work of modernizing the road network, designated by the War Department as strategically important, would be done gradually over a period of several years. Now these improvements will be rushed to completion as the No. 2 defense highway project.

"Events in recent months, however," said Administrator Carmody, "have put another phase of the defense highway program first in priority. Most urgent now is the construction of access roads. The Army alone has 130 cantonments throughout the country for which approach roads and streets must be planned. Many of the camps have been occupied by skeleton forces or not at all for twenty years. Some are newly-created. Many of the camps are expanding from a personnel of a few hundred to as many as 78,000 men. Some of them will be used for the training of mechanized troops.

"A preliminary estimate of the mileage of access-road improvements needed for the military and naval establishments alone shows a total of 2,900 miles. The cost of these improvements is estimated at $194,000,000."

New defense industries, and old ones that are expanding also will need road improvements. An example is cited of a new shell-loading plant in the Middle West which apparently will require 15 miles of road costing perhaps $500,000. The same condition exists in rapidly-expanding aircraft factories both on the Atlantic and Pacific seaboards. Hence the Public Roads Administration and the Works Projects Administration are cooperating with the War Department in organizing conferences throughout the country to determine the extent of access road building needed and the approximate cost and funds available from federal, state and local sources.

Regular federal-aid funds already apportioned to the states and not yet obligated for construction, and funds to be apportioned before January 1 total about $198,000,000 for the federal-aid system, about $38,000,000 for secondary or feeder roads, and about $68,000,000 for grade-crossing eliminations. The W. P. A. may spend up to $25,000,000 for roads and the War and Navy Departments have some funds which may be used on reservations. All this is in addition to local funds which may be tapped.

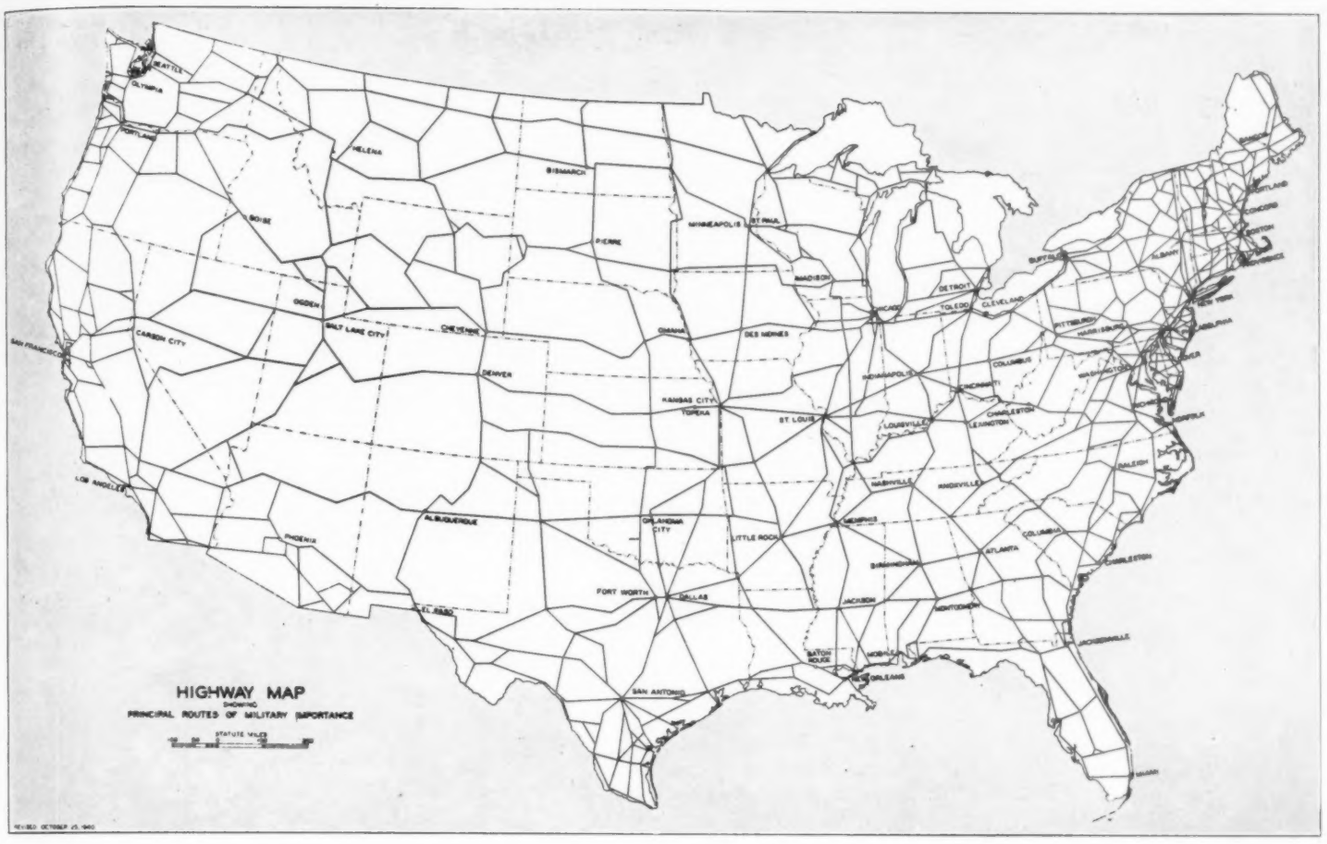
"The immediate program," said Mr. Carmody, speaking of the access road developments and the strengthening of recognized strategic highways, "does not include many important projects such as the construction of express highways through or around cities as these things must necessarily take their place in a long-term highway program."

For the conditioning of the main highway system as the second step in the adaptation of roads to the national defense the Public Roads Administration has issued a new map indicating the location of the 75,000 miles of strategic highways selected by military and naval authorities as highly important for definite strategic reasons.

The plan is not to build a lot of new highways on a grand scale but simply an up-to-date revision of the plan presented in the Pershing Map of 1922,—the first plan of a system of highways made for defense purposes by American military authorities. Although the highway development since that time has proceeded with a general aim of maintaining this system the rapidly changing methods of warfare show that the widening, strengthening and re-bridging of many portions of the system must be undertaken without delay.

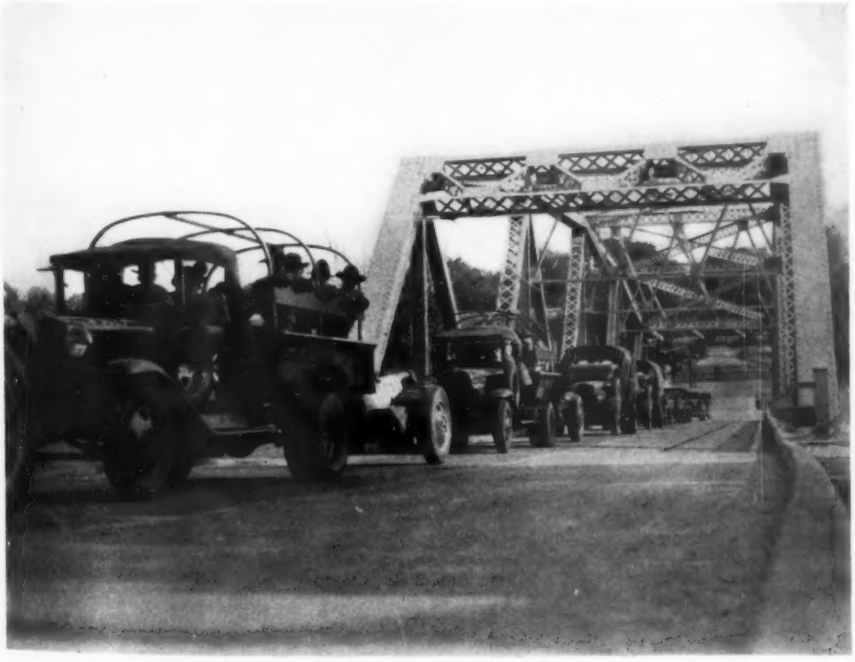
"The Public Roads Administration," said Representative Cartwright, "is now analyzing and tabulating the data which has been collected by state road authorities on the condition of this system. A report will be submitted to the President by Federal Works Administrator Carmody.

"The full size and cost of the job will be known when the Public Roads Adminstration completes its study but the government and the states should be in position to begin the needed improvements. The Federal Highway Act of 1940, approved by the President, September 5, for example, contains the following provision:



"In approving federal-aid highway projects to be carried out with any unobligated funds apportioned to any state, the Commissioner of Public Roads may give priority to, and expedite the construction of, projects that are recommended by the appropriate federal defense agency, and are important to the national defense."

Above the Pershing map of 1922 which will receive first attention in building the road network up to modern standards. Below highway bridges designed under H-15 standard are fully capable of carrying all army equipment.



Special studies of military requirements show, Representative Cartwright pointed out, that bridges designed for the standard H-15 loading of the state highways officials association, can readily carry all classes of military equipment other than tanks without special control of the movement. They also can carry the heaviest tanks, those weighing 50 tons, if the tanks are spaced at least 50 ft. apart and the speed reduced to four miles per hour.

"All road surfaces on the strategic system," he said, "should be dustless and capable of supporting 9,000 lbs. wheel loads under any weather conditions. Such surfaces will be fully capable of carrying all military loads including tanks. All surfaces less than 18 ft. in width should be widened immediately to at least 20 ft. and to 22 to 24 ft. if a large volume of traffic is expected. There are many sections of road on the strategic system built years ago that have sharp curves and steep grades. All such sections should be modernized immediately.

"The military experts have asked for only one kind of road improvement that goes beyond present accepted standards for a modern road, and that is for shoulders wide enough for parking vehicles along highways used by military and civil traffic. As a minimum requirement it is desired that parking places be provided. for a distance of 2,000 ft. at least every four miles. The widened sections on the two sides of the road should be staggered so that parking space will be found on one side of the road at least every two miles."

Unique Pressure Maintenance Project at LOUDON

By C. G. Herrington
The Carter Oil Company
Mattoon, Ill.

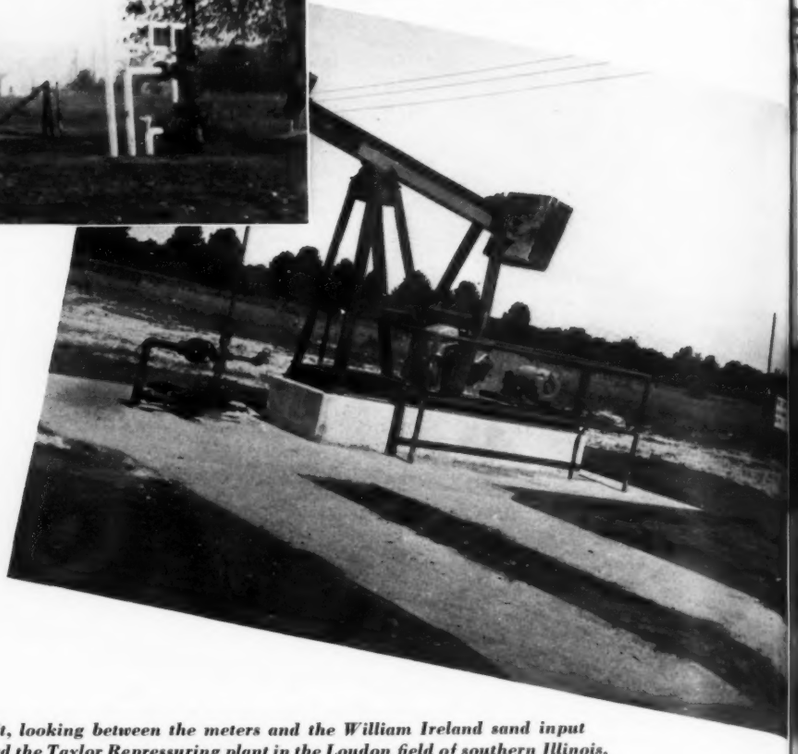
Pressure Maintenance Began Almost Simultaneously With Field Development—Multiplicity of Erratic Producing Formations Make This Southern Illinois Conservation Project Highly Complex—Significant Data For Like Operations in Future.

INTENSIVE exploitation in the Illinois portion of the Eastern Interior Coal Basin during the past three years has resulted in the development of the Loudon Pool as one of the two large discoveries in that area which now rank among the principal pools of the United States. Located on the western edge of the deeper part of the Illinois Basin in Fayette County, the indicated productive outline, with development practically complete, contains approximately 20,000 acres located in Townships 6, 7, 8, and 9 North and Ranges 2, 3, and 4 East of the Third Meridian. On September 1, 1940, the average daily production was 74,300 bbl. from 1,647 wells, having an accumulated total production of 38,135,688 bbl.

In addition to its importance from a producing standpoint, the Loudon Pool is the location of one of the industry's outstanding large scale gas injection projects. Matching the revolutionary character of the pool's general development program which is based on the use of removable casing sections in the completion of multi-sand wells, this gas injection employs the most modern practices. It is achieving the anticipated results simultaneously with the solving of many complex producing problems inherent to the operation of any pool having a multiplicity of producing formations.

GEOLOGY

As shown by the contour map in Figure 1, drawn on the Glen Dean limestone top, a marker bed encountered at a depth of 1,230 ft.



Upper left, looking between the meters and the William Ireland sand input well toward the Taylor Repressuring plant in the Loudon field of southern Illinois. Directly above may be seen a typical pumping unit in the Loudon field. On the right is the William Ireland sand input well. The lowest pipe is for gas to the Weiler sand of the upper formation. The middle pipe carries gas to the Paint Creek sand and the top pipe returns gas to the Bethel sand of the lower formation.

production is from an anticlinal structure whose axis lies in a northeast-southwest direction. It is the largest and most pronounced of a series of structures extending over a 50-mile trend which includes the Dix Pool of Jefferson County at the southern extremity.

Production at Loudon is currently being obtained from three sandstones, namely, the Weiler at 1,390 ft., the Paint Creek at 1,460 ft., and the Bethel at 1,500 ft., in the Chester series of the upper Mississippian group. The first two named are comparable in quality. The Bethel sand, however, is somewhat superior in regard to uniformity and, consequently, it is expected to have a slightly higher ultimate yield per unit of reservoir volume.

These formations are a part of the immense delta deposit underlying Central Illinois and parts of Indiana and Kentucky which was deposited in shallow offshore waters. This type of sedimentation resulted in considerable irregularity of the producing formations due to the deposition of an intermixture of sand and shale. Erratic sand quality is not only manifested by the irregular producing

Above, reading from left to right, Brauer absorption tower; precontact tower; main gas contact tower for the Lectrodryer; main wet gas absorber and reabsorber for plant vapor recovery.

characteristics of the wells, but also by wide variations in sand thickness, permeability, and porosity. The average thickness of the Weiler sandstone is 22 ft., of the Paint Creek 15 ft., and of the Bethel 15 ft.

PRODUCTION PRACTICE

Edge-water encroachment has become evident in areas of high volumetric withdrawals and especially in the southern portion of the pool; however, an active water drive does not exist and the pool is essentially one of gas drive characteristics.

The discovery well, The Carter Oil Company's Jack Smith No. 1, was drilled in Section 12, Township 8 North, Range 3 East, but it was not complete as a Weiler sand producer until after the same company's Ada Clow No. 1, located in Section 15 of that township, was completed in the Paint Creek sand on December 27, 1937. An extensive exploratory campaign followed during the summer of 1938 and the areal extent of the pool was quickly defined. Rotary tools have been used almost exclusively, except in completion work for which cable tools are preferred, and normally the oil string casing point is reached on the fifth day of drilling. The frequent moving of drilling tools necessitated the use of light-weight, highly portable rigs suitable for shallow drilling. Surface casing is not widely used, and the oil string ranges from 5½ in. to 7 in. OD. For increased protection against the corrosive water present in the upper formations, the casing is usually cemented to the surface. Welded casing is used exclusively by the major operator in the pool. Electrical well logging devices have been used with marked success in obtaining geological information, having to some extent replaced the conventional method of examination of drill cuttings and cores.

The tightly cemented, compact pay formations require shooting with nitro-glycerine to obtain satisfactory production rates. The exposing, and producing after shooting, of all of the sands in a common well bore was made possible by extensive experimentation in well completion practices which culminated in the widespread use of special casing sections. These alloy sections may be placed in the regular casing string opposite the upper formations and later removed, when desired, by milling, acidizing, or shooting directly with nitroglycerine.

Initial potentials are unpredictable due to the irregular character of the producing formations, but generally average about 250-300 bbl. per 24 hours. Artificial produc-

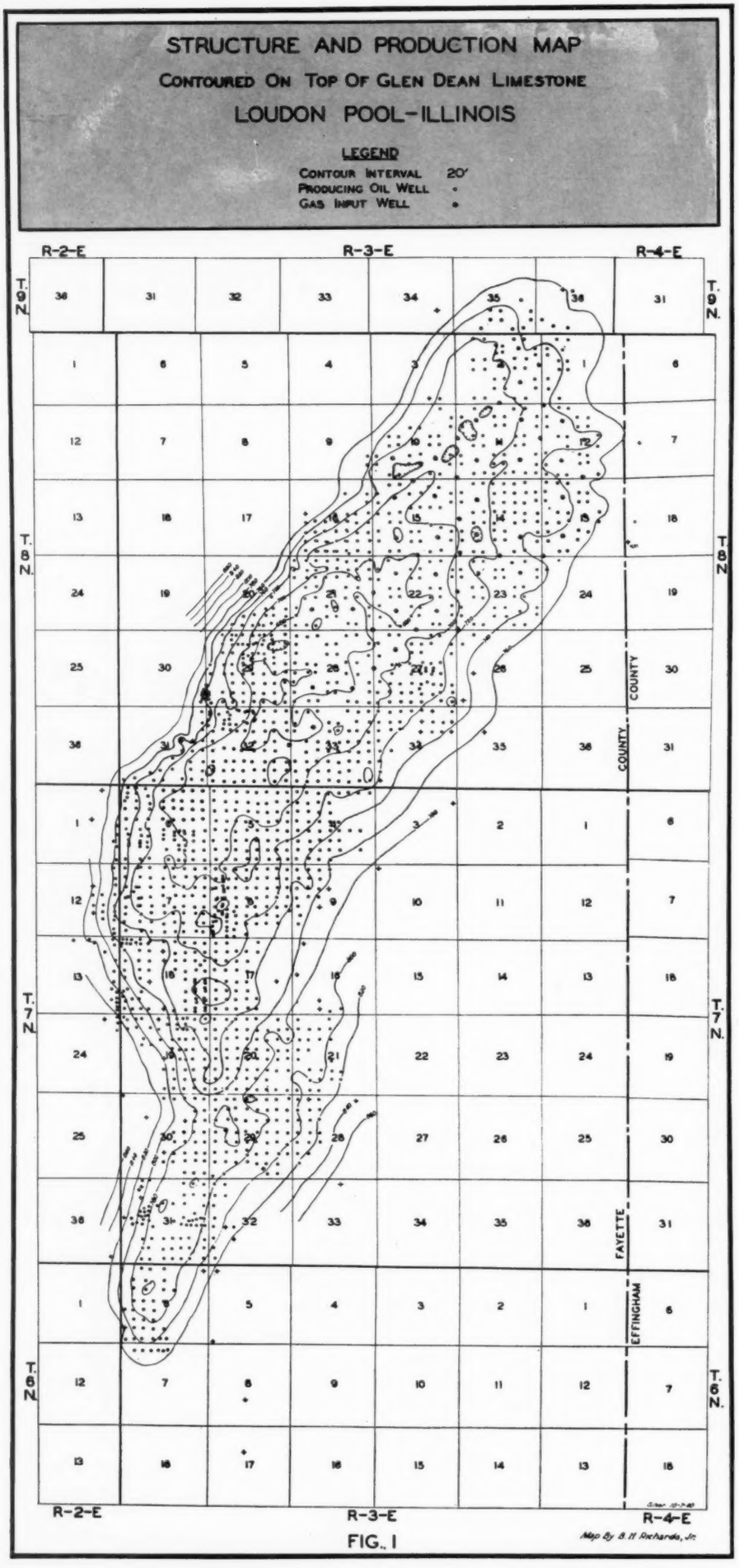


FIG. 1

tion methods are required by 85 percent of the wells and sucker rod pumping is the accepted means, with small individual pumping units, powered by an electric motor as shown in an accompanying illustration being used by numerous independent operators as well as the major operator in the pool. Production in the repressured portion of the field has been at the rate of 30 bbl. per well per day, while in non-repressured areas the rate ranges as high as the capacities of the wells.

It will be noted from Figure 2, that the Salem Pool declined from a peak daily production of 258,500 bbl. to 162,000 bbl., a decline of 37.3 percent, in five months and that the rate of decline at Centralia has been considerably higher. Meanwhile, the production of Loudon has remained practically constant, at slightly less than 75,000 bbl. daily. Loudon's more stable production rate has been the result of a systematic development program during which all possible efforts have been directed toward conservation of the reservoir energy.

GAS INJECTION

The major operator inaugurated a gas injection program early in the life of the pool which may best be called an early life or high pressure repressuring project. In the past, repressuring has usually been applied to reservoirs which had been practically depleted under normal production methods and has amounted merely to supplying a differential pressure to the reservoir which tended to drive the almost gas-free oil from the pore space in the formation to the producing wells. The Loudon repressuring project differs to the extent that it was inaugurated at the very beginning of the pool's development to stimulate the natural movement of reservoir fluid while it was still in its most fluid state. Also, as will presently be discussed, the volume of gas available is limited and conservation of the meager supply was necessary.

Proper application of the principles of early life gas injection forestalls reservoir energy dissipation, and makes unnecessary the drilling of numerous wells which normally would be drilled if secondary recovery methods were not to be relied upon until late in the pool's life. It also permits the use of wider well spacing pattern in the development operations. The Loudon Pool's well spacing varies as dictated by property lines from about six wells per acre on roadways and other small tracts to a more general spacing of one well per twenty acres on larger tracts in the repressured area and ten acres per well in unrepressured areas. These differences in well spacing are readily noted in Figure 1. The Carter Sunflower spacing pattern, providing for the drilling of two wells on each forty acre land sub-division with the wells being located in the center of

Contour map drawn on Glen Dean limestone, a marker bed encountered at 1,230 ft. in the Loudon field in southern Illinois.

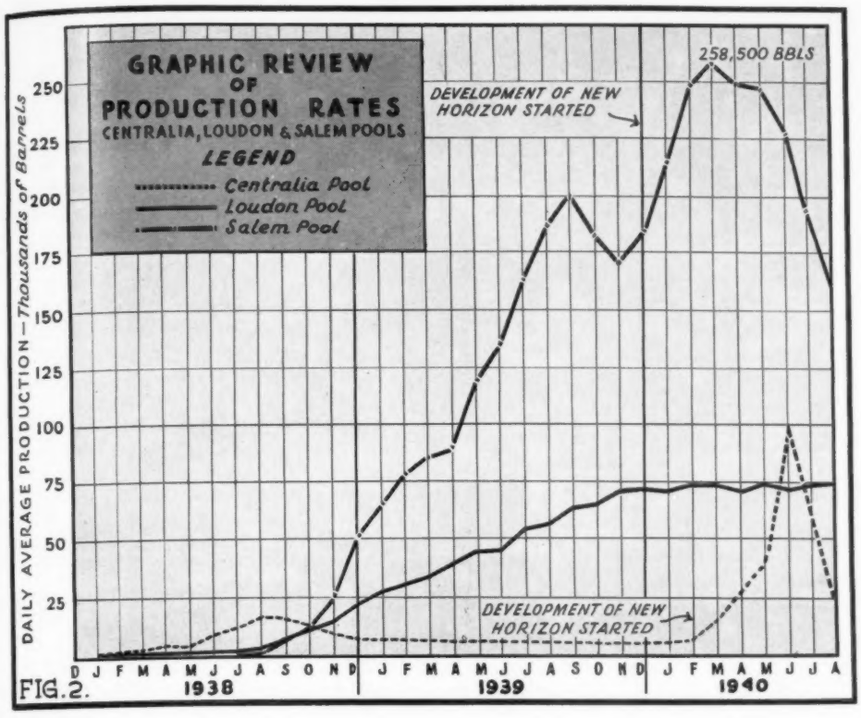


FIG. 2.

Above, note decline in Salem and Centralia production compared with fairly constant production at Loudon.

diagonal ten acre tracts, is illustrated in Figure 3. It will be noted that an octagonal design is formed by the eight producing wells surrounding each input well and that each oil well is directly affected by two input wells.

In the completion and equipping of input wells, provision is made for controlling and metering of the gas injected into each individual sand. All pay formations are cored in the drilling of input wells with casing being set on bottom and cemented to the surface. Laboratory analysis of the cores obtained and careful study of cross-sections of the immediate area serve as a guide in perforating the casing to expose the formations to the incoming gas. To clean and condition the hole properly, a swabbing test of at least 24 hours is taken, after which the hole is unloaded of fluid by gas-lifting and the well is placed in service. To date, occasional blowing of the input wells has resulted in the removal of any material deposited over the sand face and further reconditioning has not been necessary. Control of the gas going into each of the three producing formations is accomplished through the use of two strings of tubing, a small-size string inserted inside the larger, and a double packer arrangement employing a special bottom hole valve assembly which prevents the escape of gas from the larger string of tubing to the lower formation, served by the smaller tubing. The special well with manifold designed for the delivery of gas into both strings of tubing as well as the annular space between the casing and largest string of tubing is shown in an accompanying illustration. Equipment used in the input wells, or the connecting system, is designed to withstand 1,000 lbs. per sq. in. working pressure.

GAS-OIL RATIOS

Initially, static subsurface pressures of the three producing formations at Loudon approximated the two hydrostatic head, with a normal pressure gradient existing between formations. The Weiler sand's static pressure was estimated to be 625 lbs. per sq. in., the Paint Creek's, 650 lbs. per sq. in., and the Bethel's, 660 lbs. per sq. in. In that portion of the pool surveyed in July 1940, the Weiler's pressure had declined to 348 lbs. per sq. in., the Paint Creek's, to 363 lbs. per sq. in., and the Bethel's, to 371 lbs. per sq. in. Near capacity production of all leases lying south of the first tier of section in Township 7 North, has resulted in the static pressure of that area declining below 200 lbs. per sq. in. In the northern portion of the pool, pressure decline is greatly retarded by not only the lower volumetric withdrawals, but to a much greater extent, by the volume of gas injected.

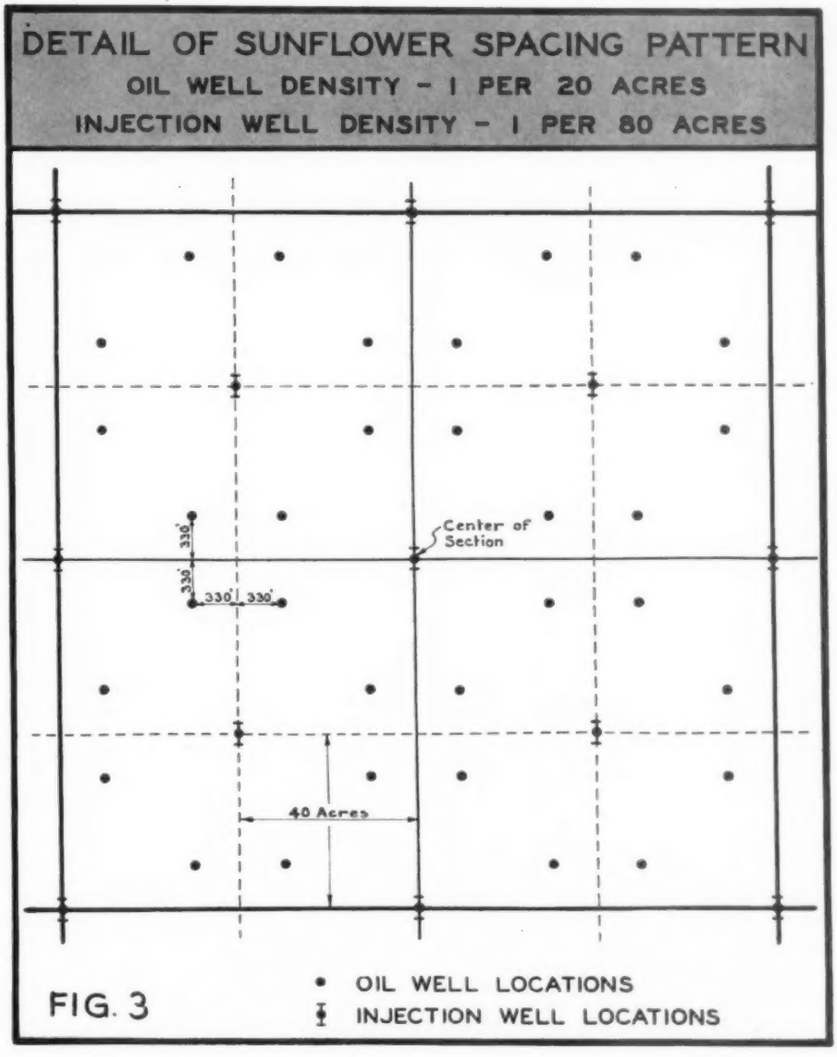
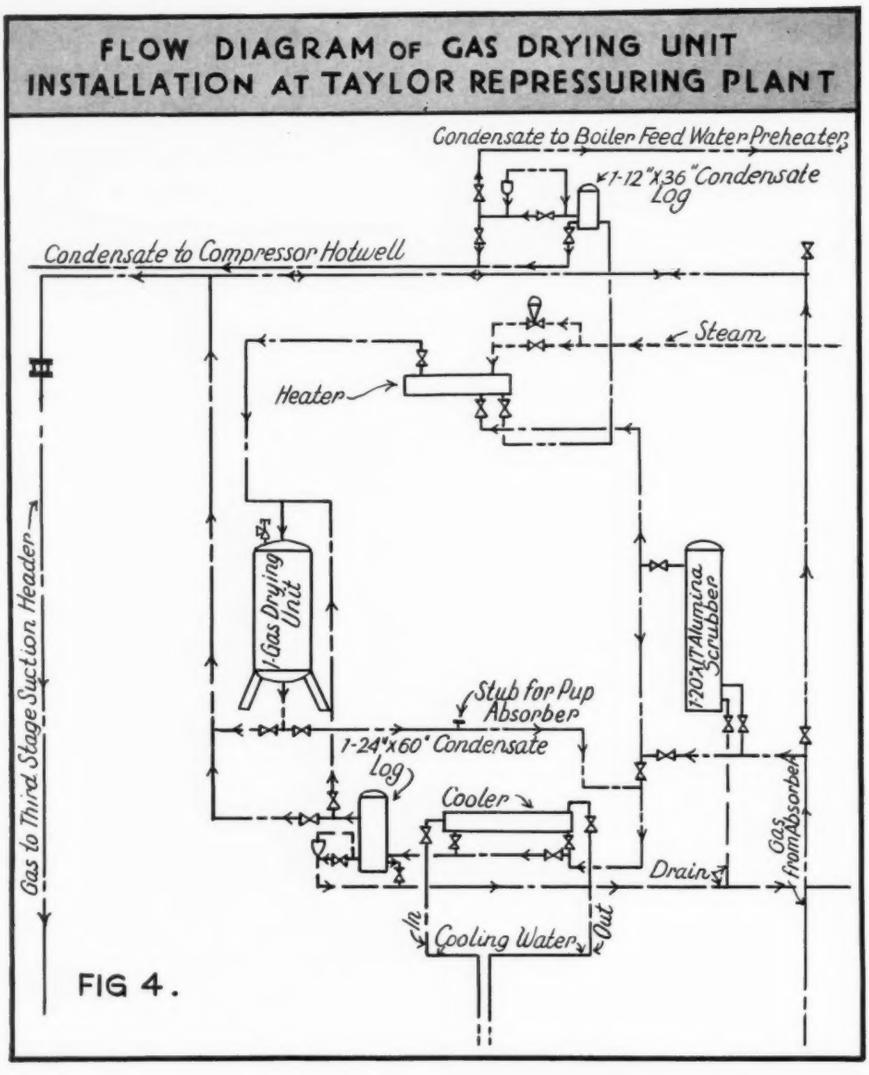
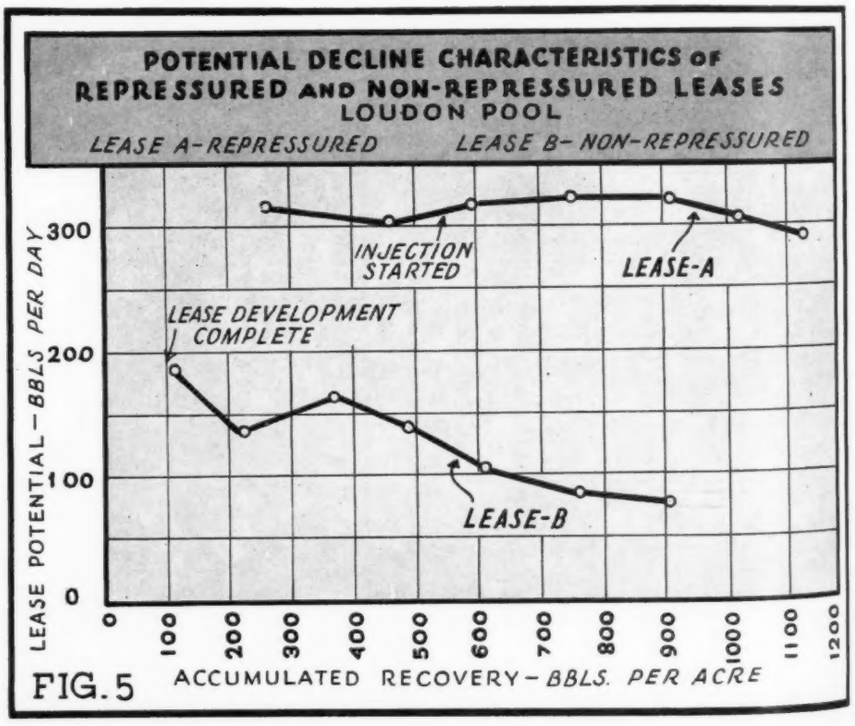


FIG. 3



In certain small localized areas, erratic pressure behavior has been observed which can be attributed to the poor quality of the formation preventing normal pressure equalization.

At the reservoir's original static pressure, the oil was fully saturated with gas and relatively small free gas caps were present on the crest of the structure in both the Weiler and Paint Creek formations. Analyses of reservoir fluid samples indicated that 220 cu. ft. of gas per barrel were originally in solution. The dense development with correspondingly high withdrawals in the southern part of the field, together with its low structural position, which resulted in smaller ratios, explain the present low produced gas-oil ratios of from 100-200 cu. ft. per barrel in that area. In the repressured territory, producing at restricted rates, the initial produced gas-oil ratio was in the neighborhood of 400 cu. ft. per barrel, and as would normally be expected, it has now increased. Numerous individual well tests have shown that the ratios are roughly proportional to the producing rates and the observed gas-oil ratios with the wells producing at capacity rates are approximately twice as large as those encountered in normal operation with production being obtained through chokes at the restricted rate. To hold the produced ratios at a minimum and thus conserve reservoir energy, each well in the repressured area produces at a restricted rate.



OPERATION

Since the necessity of determining the reaction of the Loudon producing formations to injected gas by experimentation was recognized, a small pilot compression plant, having a capacity of 2,500,000 cu. ft. daily, was constructed in Section 15, Township 8 North, Range 3 East. Two 300 h.p. four cylinder, two cycle, angle type compressors having a daily capacity of 1,125,000 cu. ft. each when delivering gas at the rated pressure of 750 lbs. per sq. in. were installed. Gas was gathered from 56 wells and compression was accomplished in three stages with the first stage gathering the gas at eight inches mercury vacuum and discharging it at 40 lbs. per sq. in., the second stage increased the pressure to 250 lbs. per sq. in., and the third stage delivered gas to the high pressure distribution system, serving five input wells in Section 15, Township 8 North, Range 3 East, at 750 lbs. per sq. in. No provision was made in the original plant for the manufacture of a finished product. As will later be discussed, the reaction of the reservoir to injected gas exceeded expectations and expansion of the project on a wide scale was begun in the summer of 1939. The original plant was doubled in capacity and a second plant having a capacity of 5,000,000

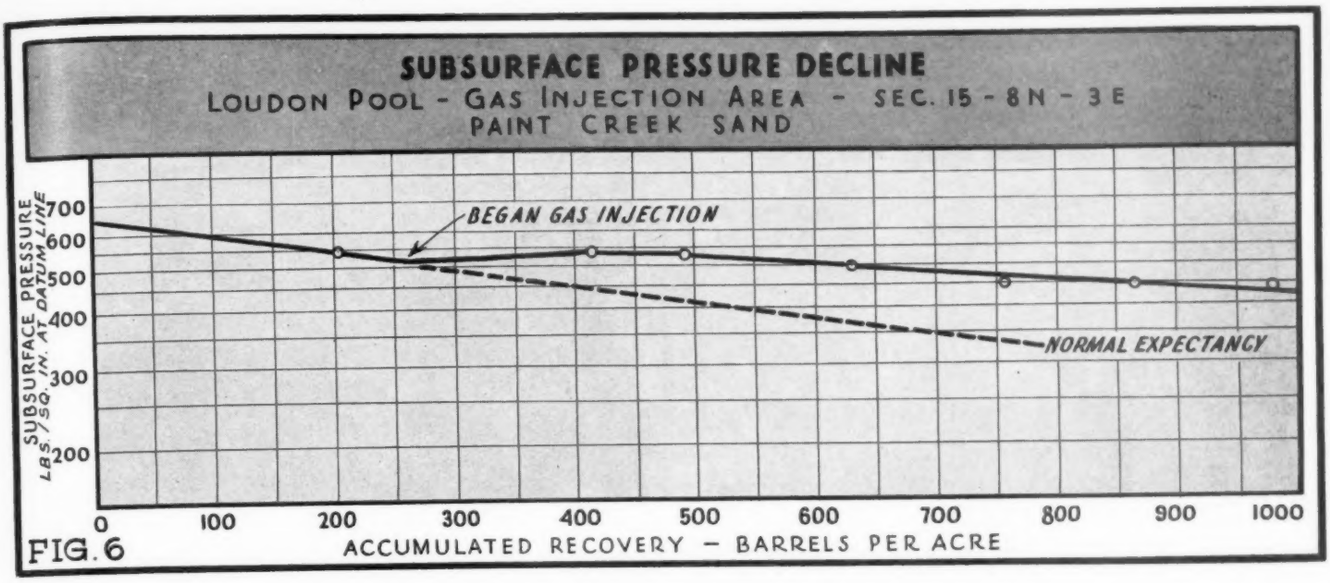


FIG. 6

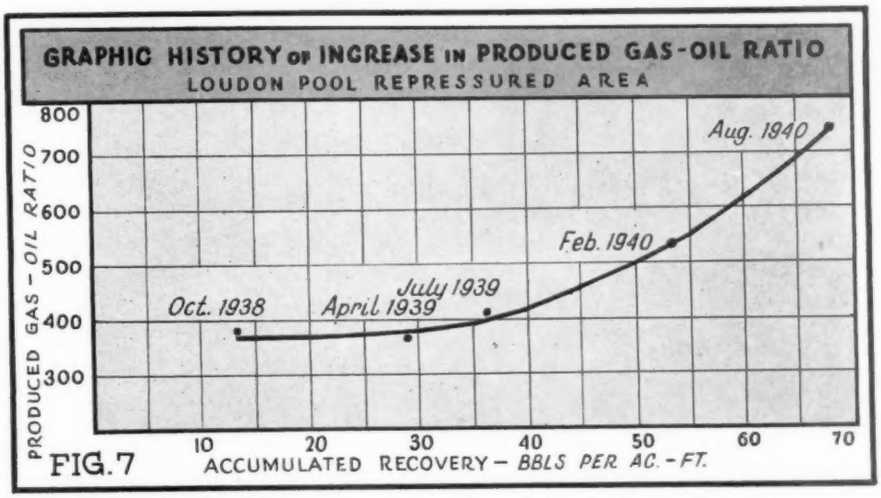
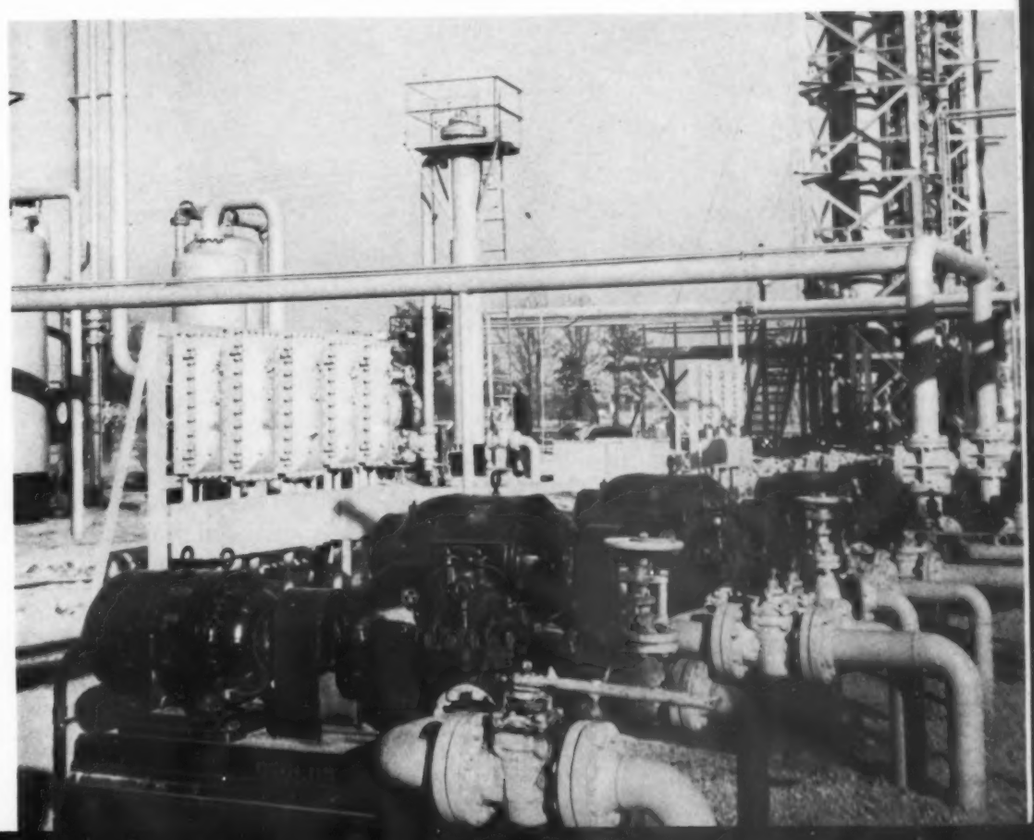


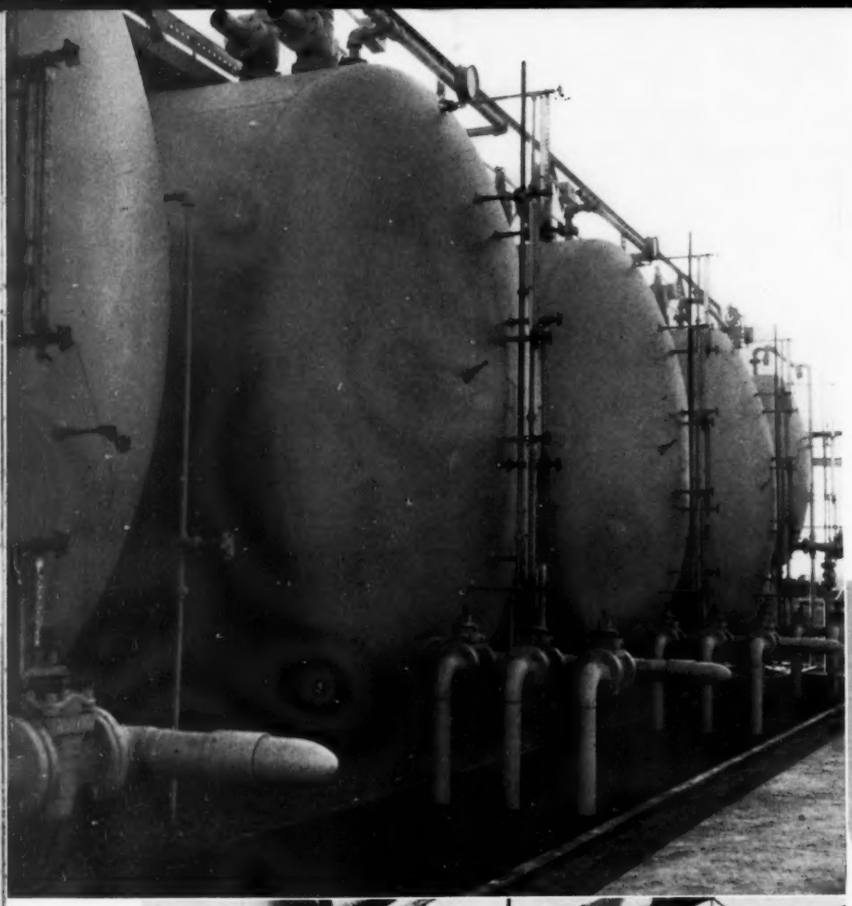
FIG. 7

Right, battery of pumps used for circulating absorption oil to Taylor and Dove plants and reflux for main gasoline still and No. 1 stabilizer. In background may be seen partial view of No. 2 and No. 3 fractionating units, in process of installation.



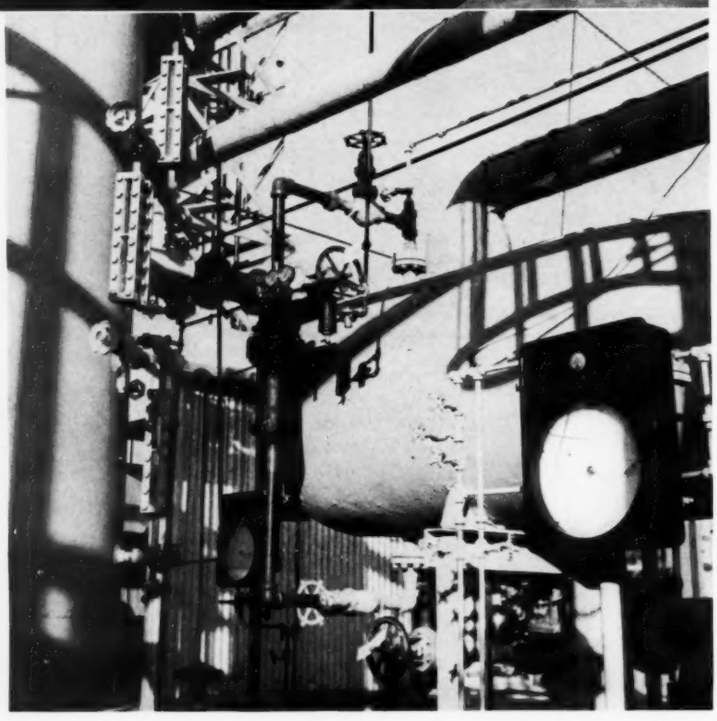
cu. ft. daily, was constructed. Thus, the combined capacity of the two plants is now 10,000,000 cu. ft. daily and corresponding absorption, fractionation, and stabilization equipment has been added.

To insure the continuous delivery of high pressure gas to input wells by elimination of line stoppage due to freezing, an adsorption type dehydrator was installed at each plant. The moisture in the gas is absorbed by activated alumina. As shown in Figure 4, the gas first passes through an alumina filled pre-contact tower and a water cooler where excess moisture is removed before entering the drying unit. Passing downward through the dryer, the gas stream is broken up by passing through the granular adsorbent effecting an intimate contact with the alumina surfaces. Moisture particles adhering to the large exposed alumina surface do



Left, four of the 2,400 gallon capacity storage tanks for 26-70 gasoline and the 1,400 gallon raw feed tank.

indicated a slight increase in reservoir pressure for the 640 acres affected. Additional evidence supporting this early indication of the reservoir's reaction to gas injection was obtained in April, 1940, when oil and gas potential tests indicated that the 32 producing wells, surrounding the five input wells, had suffered no appreciable decline in oil potential since injection was begun while similar wells, not benefitted by the injected gas, had shown a marked decline. Also, the gas potential of the wells affected had appreciably increased, especially in those wells having



Above, main gas absorber and re-absorber; re-absorber at left.

Left, reboilers for No. 3 fractionating tower.

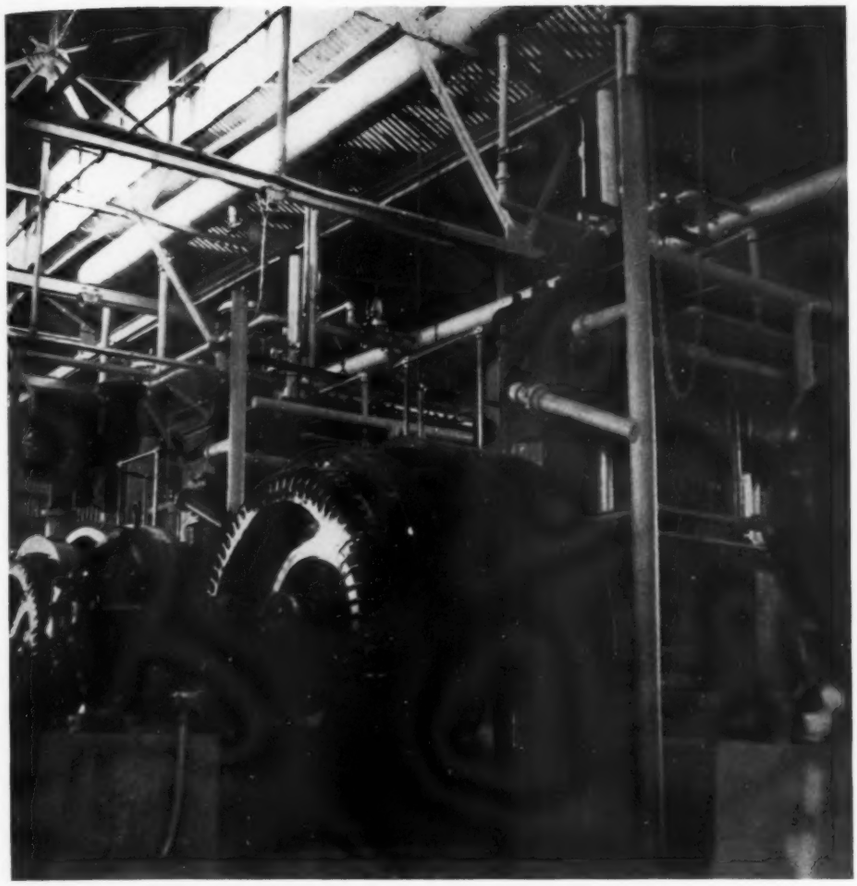
the better sand bodies. Particular importance was attached to these early indications due to the fact that, in every instance, they occurred in areas having highly permeable sand, since experience in other pools has shown that these areas should be the first affected. In July 1939, the average daily volume injected was reduced to approximately 25 percent of the volumetric withdrawal from the reservoir in the repressured areas. This rate has since been maintained except during the winter months of 1939 when, prior to the first installation of gas drying equipment, freezing of the gas lines prevented regular injection of the desired volume.

The daily volume currently being returned to the reservoir is in the neighborhood of 1,100 MCF. As the gas-oil ratios increase in the future, the volume of gas injected will be increased, as necessary, in order to maintain a return of approximately 25 percent of the volumetric withdrawals.

not alter the adsorbent chemically or physically and may be easily removed by circulating steam heated gas through the unit. This drying equipment reduces the dew point by at least 90 deg. F. and entirely eliminates the installation of drips on the high pressure distribution system.

Fifty-five input wells, serving an area embracing 4,400 acres have now been drilled. Progressive enlargement of the repressured area is planned with a total of 2,000 acres to be added by the drilling of 25 input wells.

The pilot compression plant was placed in operation on November 29, 1938, and gas was returned to the Paint Creek formation through five input wells at a daily rate of approximately 3,000 cu. ft. per well. A static subsurface pressure survey in March, 1939,



As an illustration of the influence of gas injection on potential decline, the curves of one of the oldest fully repressured leases (Lease A) and of a similar non-repressured lease (Lease B) are shown in Figure 5. It will be noted that there was no appreciable change in the potential of Lease A until recent months and that the present rate of decline is normal. In contrast to the small change in potential of Lease A, the potential decline curve of Lease B shows a consistent downward trend, and these wells suffered a decline in potential of approximately 60 percent while producing a total of 900 bbl. per acre. The latter curve is typical of leases developed on the twenty-acre Sunflower spacing pattern and produced at the same rate as that in effect throughout the repressured area, but differing to the extent that their inclusion in the repressuring program has been delayed.

The weighted average subsurface pressures of that part of the Weiler, Paint Creek, and Bethel sands not affected by injected gas produce a straight line when plotted against recovery per acre on semi-logarithmic paper. The same characteristic decline may be noted of the weighted average values in the repressured area until gas injection was inaugurated; thereafter, as shown in Figure 6, a deviation from the expected rate of decline occurred. These decreases in the rate of pressure decline are conclusive evidence of the beneficial effect of gas injection since the higher pressure not only tends to hold more gas in solution and lower the viscosity of the reservoir fluid, but it also acts as a stimulant to the natural flow of fluid through the pore spaces.

Successive surveys of the wells' producing characteristics have shown increases in gas potentials and gas-oil ratios. Progression of this advancement in gas potentials has been outward from the input wells and following the zones of superior sand characteristics. As previously stated, the original produced gas-oil ratio was a little under 400 cu. ft. per barrel and this has now increased, as indicated in Figure 7, to 745 cu. ft. per barrel. Gas-oil ratio increases in comparable non-repressured areas do not approach in magnitude the rate of increase observed in the repressured areas and it can only be concluded that the injected gas is filtering through the formation and reducing the consumption of natural reservoir energy.

CONCLUSION

The multiplicity of erratic producing formations as encountered in the Loudon Pool and the modern practice of completing the oil wells in such a manner as to produce, in the open hole, two or more sands tend to make this one of the most complex gas injection projects now in operation in the industry. That these problems are being overcome is evidenced by the behavior of the reservoir to date, and future operations of this project will, without doubt, permit the accumulation and distribution of considerable information of value in planning the operation of future projects of like character.

ACKNOWLEDGMENT

The author wishes to express his appreciation to The Carter Oil Company for permission to publish the data presented in this paper.

Above, the 1,295 h. p. electric generators of Carter Oil Company's repressuring plant in the Loudon field. Right, Perco towers used for treating gasoline in foreground and No. 2 fractionating tower on left in background for manufacture of butane and 26-70 gasoline. On right in background, No. 3 Tower for manufacturing propane.

ROCKEFELLER: The Definitive Biography by Allan Nevins

JOHN D. ROCKEFELLER by Allan Nevins: 2 vols. 1430 pages, pub. by Charles Scribner's Sons, New York: $7.50

AGAINST a huge but infinitly detailed background of the economic and industrial development of the United States, Allan Nevins has painted the first truly complete and impartial portrait of John D. Rockefeller, one of the most significant figures of the heroic age of American business. This is in fact the definitive biography of a man who had a profound influence on the age in which he lived, and of whom so much has been written that was violent, biased and partisan. Sufficient time has now elapsed to make possible an impartial survey, not only of John D. Rockefeller and his gargantuan Standard Oil Company, but also of the economically boisterous time in which he lived and in which were born and matured some of the great industrial organizations of present day America.

Not only was the time right for a biography in detail and without passion or bias, but also public interest in this great figure was fortunate in that an author so completely impartial and so obviously accurate was available to undertake the work. In the words of John Chamberlain, reviewing Nevins' book in the NEW YORK TIMES: "Allan Nevins could be judicious even if a cannibal were about to eat him . . ."

Nevins himself says:

> "The career of John D. Rockefeller is one of the most interesting and significant in American history, stretching over a span of almost one hundred years it is in many respects unique and in some of monumental importance. Indeed, it may be said that our industrial history since the Civil War can hardly be understood without a clear grasp of the principal facts of Rockefeller's work. By far the greater part of the material in print upon this career is violently controversial, and almost none of it is unbiased. The few attempts that have been made to present an objective, and impartial account of Rockefeller's life have been too limited in scope to deal with the subject thoroughly. There has plainly been great need for a biography which should review all the transactions of his life, both candidly and carefully, without prejudices or preconceptions.
>
> "This book is an attempt to meet the need. It is an effort to illuminate without fear or favor all aspects of the work of a remarkable innovator, who left a deep imprint upon both the industry and philanthropy of the nation, and who has been both bitterly assailed and warmly defended. The biography was undertaken in a spirit of impartiality and under circumstances which assured the complete independence of the author.—If the author brought any bias to his work, it was that of a convinced believer in a free competitive economy."

The technique adopted by Nevins to analyze and interpret this important figure has been one of infinite detail. Obviously the author felt and correctly that his subject was of such profound significance, not only to the age in which he lived, but to the direction in which American industrialism has since developed that any amount of detail was justified in making clear, not only the man and his work, but also the background against which his life was carried on. Several hundred pages are devoted to Rockefeller's youth and to his start in business; however, when one has finished this section of the book, one feels familiar not only with the young man, his aims and with at least a part of his philosophy, but also with the manner of life in western New York of the 1840's and 50's. The picture of Rockefeller's youth is complete, but so also is the picture of his father, his mother, and the community in which he lived, the people with whom he came in contact and the attitude of his day towards business, industrialism and religion.

A consideration of Nevins' biography is not complete without a glance at some of the previous works on this important figure. Henry Demarest Lloyd, Ida Tarbell and more recently John T. Flynn have all undertaken biographies of Rockefeller. All have been frankly biased in their treatment of the subject; in the case of at least the first two of these authors, their personal feelings have been engaged to an extent that would make their writing appear, at least today, highly unreliable. Lloyd was concerned with the exploitation of the consumer and during the period when he was writing, competition had not so clearly developed as to make this a matter of little significance. Not only was he attacking the Standard Oil in the 1880's but he was also also attacking the whole industrial conception of cartels, rings and monopolies that threatened to create an American economy patterned on that of Europe. Ida Tarbell was too well acquainted personally with the tragedy of the little Pennsylvania oil producers who had been forced to the wall by the formation and the tactics of what appeared to her a monstrous monopoly. Neither author seems to be concerned with the bankruptcy, unemployment, and panic that resulted from constant and devastating price wars. John T. Flynn, who in point of time, had the same opportunity as Allan Nevins to secure a proper and impartial perspective on his subject, was not the type of writer for the detailed and definitive work that was called for by the nature of his subject. Flynn painted in bold colors; he employed a technique of broad general impressions rather than a painstakingly detailed mosaic.

It should not, however, be taken for granted that Mr. Nevins defends the subject of his monumental work. He deals at length for example with the notorious South Improvement Company. Clearly he condemns the use of this instrument to destroy free competition. He is at pains, however, to obtain a proper perspective toward the South Improvement Company and demonstrates adequately that it was a device invented, not by Rockefeller, but rather by the three railroads engaged in competition through Pennsylvania. In establishing the fact that such manifestations as the South Improvement Company were the logical outcome of the phenomenal growth and unrestrained development of industry in the United States, Nevins does not seek to relieve his subject nor the other men engaged in these dubious practices of the responsibility for inventing and using such techniques.

A great deal of the second volume is devoted to the tremendous benefactions that reached such colossal proportions in the latter half of Rockefeller's life. The biography clearly demonstrates that this was not a development of that period of Rockefeller's life. It was simply the consistent outgrowth of a philosophy that he had adopted and practiced long before he had at his disposal such means as to make his philanthropies of world-wide importance. As is well known, young Rockefeller, even on a very moderate salary as a bookkeeper for a Cleveland firm, was already contributing in a systematic manner to the charities that most strongly appealed to him as worthy of support. Nevins makes clear that the huge gifts and foundations for which Rockefeller was responsible were no mere conscience-salving gesture to regain public goodwill that had been lost through the monopolistic practices of Standard Oil. Not only is the origin and development of this philosophy clearly traced by the author, but if he does nothing else, he makes it abundantly clear that Rockefeller was not the type of person to attempt by philanthropy to justify his earlier actions to a public whose opinion did not greatly interest him. Analytical and non-emotional it is clear from Nevins work that he was both certain of the course he was going to pursue and unimpressed by any fancied need for explaining his actions or motives to people outside his business and family.

Rockefeller's associates in the early, middle and later period of his life emerge from the Nevins' book very clearly. The development and operation of Standard Oil is so well analyzed and explained that one must conclude that the book is required reading for those interested in the petroleum industry. A careful perusal of the two somewhat lengthy volumes will amply repay those associated with the industry on which Rockefeller has had so great an influence. It is true that Nevins' book can hardly be classed as light reading; the very nature of his approach

to the subject and the subject itself are such as to preclude this possibility.

No reference to this book would be complete without calling attention to the remarkable collection of photographs that are here reproduced. Mr. Nevins and the publisher have had access to the Rockefeller collection of photographs. The reproductions are extremely interesting and help considerably to lighten the textual matter. The illustrations cover many phases of Rockefeller's life and a number of early oil scenes such as the one reproduced herewith, although the accompanying photograph is not actually from the Nevins' book. In addition to the photographs there are reproduced in this work a large number of cartoons dealing with Rockefeller and the Standard Oil.

No doubt there will be other biographies, perhaps adding a few new facts to what is already known of Rockefeller's life, but at this time it is difficult to see how such a work could contribute a great deal more than is contained in Allan Nevins' biography. Painstaking, impartial, accurate and above all complete, seem to sum up the work of this author so well qualified to deal with the subject that he has undertaken.

The early days of the American petroleum industry the course and development of which was so profoundly influenced by John D. Rockefeller whose life is accurately portrayed by Allan Nevins.

Foreign Oil Legion

EDWIN H. ARMSTRONG, Professor of Electrical Engineering at Columbia University and a pioneer in the field of F. M. (frequency modulation) received the Holley Medal of the American Society of Mechanical Engineers at the meeting of that organization on December 4th, in New York City. The Melville medal for original engineering work was presented to Carl A. W. Brandt at the same meeting of the ASME. Mr. Brandt was chief engineer of the Super Heater Company, New York.

A. J. Hamon in charge of Shell Oil Company's aviation activities.

J. H. Lee

•JOSEPH H. LEE has been placed in charge of all lubricant sales east of the Rocky Mountains for Shell Oil Company, Inc.

•DAVID WAXMAN, formerly of Philadelphia, has been appointed manager of Shell Oil Company's asphalt department according to an announcement of the President. Mr. Waxman will make his headquarters in the New York offices of the Shell Company.

•JAMES S. ALCORN, President of the Alcorn Combustion Company, died suddenly Tuesday, November 5th, at Wynnewood, Pennsylvania. Mr. Alcorn was a graduate of Central High School, and attended the University of Pennsylvania Law School. After being admitted to the Pennsylvania bar he was for a number of years associated with the law firm of Simpson and Brown. For the past 17 years he has been president of the Alcorn Combustion Company and a Director of the Faber Engineering Company.

David Waxman

Foreign Oil Legion

JOSHUA S. COSDEN, President of the Cosden Oil Company of Fort Worth, died on November 17th while traveling by train from Palm Springs, California to his home at El Paso, Texas. Mr. Cosden is survived by his wife and one son, Joshua S. Cosden, Jr. He was 59 at the time of his death which occurred as a result of a heart attack. He had led a colorful life in the early days of oil development in Oklahoma and had amassed a considerable fortune which involved him in the financial intricacies of Wall Street where, in the fall of 1926, he lost a large part of his financial holdings. Mr. Cosden later established his headquarters at Fort Worth, Texas and again succeeded in amassing a considerable fortune, which he lost as a result of illness in 1931. His third attempt to acquire a personal fortune met with at least a partial success and while he did not attain the height that he had known in 1926, he did build a sound financial property.

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Henry Linam, (right) president of Standard Oil Co. of Venezuela being seen off by Warren Smith, vice president of Pantepec as he sailed for his headquarters in Caracas on the SS. Santa Rosa on November 29.

J. E. BRANTLY, President of Drilling and Exploration Company, Inc. left New York by plane on November 20th for a business trip to Brazil. Mr. Brantly's company has several rigs in operation in Brazil and elsewhere in South America. Some of the activities of his company in Brazil are described on other pages of this issue. Mr. Brantly expected to include in his trip a brief stopover at his winter home at Cocoa Beach, Florida for the Thanksgiving holiday and then to spend several weeks in Brazil with possible visits to other parts of South America.

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Judson Wood, vice president of Mene Grande Oil Co. C/A (Gulf) with his daughter Miss Theresa Wood as they sailed from New York for Maracaibo aboard the SS. Santa Rosa on November 29.

ROY S. LYSTER has been elected vice-president and director of Alcorn Combustion Company. Some of his earlier engineering experience was obtained with the Atlantic Refining Company and he joined the engineering force of Alcorn in 1927. By 1935, he was made chief engineer and the announcement of his appointment as vice-president and director was released on November 26th of this year.

B. T. W. Van Hasselt, general manager of Caribbean Petroleum Company (Shell) leaving New York on November 22 aboard the SS. Santa Paula for his headquarters in Caracas, Venezuela.

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William P. Buckley president of the Pantepec Oil Co. hurrying toward his stateroom as the SS. Santa Paula sailed from New York on November 22. Mr. Buckley, whose company operates in Venezuela, is en route to Caracas.

FRANK H. PRAEGER was recently elected president and director of Alcorn Combustion Company. He has been associated with the company as sales engineer ever since 1926 and has had headquarters in Tulsa, Los Angeles, and San Francisco.

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Mr. & Mrs. H. I. Fry, assistant manager of Socony-Vacuum in Venezuela returning to Caracas after a three months stay in the United States on November 15.

THE NEW YORK chapter of the Nomads wound up its affairs for the year 1940 by a gala dinner-dance held on Friday, December 6 at Louis Sherrys on Park Avenue in New York. The entertainment was very well attended, practically all members of the New York Nomads being present together with a large number of guests from out of town. Music was furnished by the Meyer Davis orchestra.

Dick Fisher (left) of Petroleum Instrument Corp. with A. J. DeJager of B. P. M. who is visiting Los Angeles from Netherlands India.

THE LOS ANGELES chapter of the Nomads held their November meeting at the Mayfair Hotel in Los Angeles on Wednesday evening, November 27th. Surprise entertainment was furnished by the speaker for the evening, John Reardon, umpire for national league baseball, who gave an interesting discussion on big league baseball and personalities of the players. In connection with this meeting it was announced that arrangements had been completed for a weekly class in Spanish to be held in the Baker Oil Tool, Inc. auditorium, for members of the organization. The November meeting was attended by a large number of oil men from other countries including Egypt, Venezuela, Trinidad, Colombia, Borneo, and Brazil.

P. L. Brooks recently appointed Pacific Coast manager of Parkersburg Rig & Reel Co. who will make his headquarters in Los Angeles.

James M. Greer, counsel in South America for Gulf Oil Co. subsidiaries as he sailed from New York November 22 on the SS. Santa Paula.

© Cosmo-Sileo

DR. RALPH T. GOODWIN has been appointed manager of fuel oil sales for Shell Oil Company, Inc. Dr. Goodwin 's appointment is part of the program of decentralization currently designed to combine the eastern and midwestern producing and marketing units of the Shell Company. Mr. Goodwin is a prominent fuel oil technologist.

Dr. R. T. Goodwin

A. J. HAMON has been placed in charge of aviation activities for the Shell Oil Company as part of its current program designed to consolidate the company's entire organization. Mr. Hamon has had extensive experience in the construction and operation of airplanes in various parts of the United States.

H. L. Curtis

H. L. CURTIS has recently been appointed sales promotion and advertising manager of Shell Oil Company and will be in complete charge of all advertising activities of the Rocky mountains. Until recently Mr. Curtis has had no advertising experience, but his appointment was the result of a theory held by the Shell Company that advertising was primarily part of sales promotion. Until recently Mr. Curtis was sales manager for the Shell Company.

BENJAMIN G. SYMON has been appointed manager of the Shell Company's technical products department according to an announcement of the Shell's president, Alexander Fraser. He will be in complete charge of all sales east of the Rockies of naphthas, solvents and other petroleum products for chemical, technical and household use. The present trend in the refining industry would indicate that this is becoming every year a more important division of an oil company's activities.

B. G. Symon

WORLD OIL

Figures in U. S. barrels of 42 —Co

U. S. BARRELS

	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	July 1940	August 1940	Sept. 1940	Preliminary Figures Oct. 1940
United States	111,885,000	115,120,000	113,140,700	108,668,800	120,075,000	116,046,000	118,283,000	111,690,000	113,244,000	110,523,00	109,337,000	107,878,000
Soviet Union	17,813,160	18,406,932	18,406.932	17,251,723	18,454,796	17,896,740	18,448,875	18,250,000	18,450,000	18,500,000	18,500,000	18,500,000
Venezuela	16,681,881	16,050,535	14,798,667	14,380,134	15,514,962	16,495,995	18,343,406	18,629,609	16,580,129	15,134,616	14,623,116	13,828,100
Iran	6,423,390	6,637,503	6,637,503	6,227,895	6,745,073	6,507,180	6,560,000	6,449,520	6,664,504	6,700,000	6,700,000	6,700,000
Netherland India: Sumatra	3,427,490	3,629,655	3,472,786	3,149,536	3,440,792	3,428,880	3,456,624	3,345,120	3,456,624	3,456,624	3,345,000	3,345,000
Borneo	1,068,349	1,086,713	1,093,743	1,062,210	1,097,516	1,063,890	1,106,080	1,070,400	1,106,080	1,106,080	1,070,400	1,070,400
Java	549,926	633,136	561,064	507,207	562,665	537,720	555,582	537,660	555,582	555,582	537,600	537,600
Molucca and Other	62,340	60,550	59,215	62,340	54,021	67,740	62,310	60,300	62,310	62,310	60,300	60,300
Rumania	3,743,041	3,842,154	3,786,908	3,595,888	3,818,554	4,422,721	3,830,236	3,682,618	3,812,557	3,865,923	3,373,020	3,131,000
Mexico	3,700,000	3,500,000	3,348,682	3,147,385	3,286,000	3,180,000	3,412,000	3,873,720	2,945,000	3,410,000	3,400,000	3,472,000
Iraq	2,530,770	2,615,129	2,615,129	2,461,723	2,666,713	2,578,020	2,644,362	2,559,060	2,200,000	2,000,000	1,500,000	1,500,000
Colombia	1,918,891	1,871,594	2,484,398	2,025,618	2,203,272	2,192,178	2,427,000	2,200,000	2,200,000	2,200,000	2,000,000	2,000,000
Trinidad	1,583,850	1,636,645	1,636,645	1,529,808	1,633,421	1,580,940	1,634,754	1,659,000	1,684,000	1,710,000	1,750,000	1,800,000
Argentine	1,621,927	1,691,123	1,671,378	1,535,460	1,682,029	1,616,171	1,684,641	1,677,338	1,762,206	1,746,543	1,785,000	1,659,930
Peru	1,116,810	1,154,037	1,154,037	1,071,869	1,139,932	1,097,400	1,143,466	1,106,580	1,143,466	1,143,466	1,106,600	1,106,600
Bahrein	563,985	632,962	631,644	581,255	636,577	579,078	616,174	602,560	620,486	622,443	598,924	621,077
Burma	753,771	708,054	666,810	629,039	689,750	666,810	679,520	657,600	679,520	679,520	657,600	657,600
Canada	731,209	502,920	486,859	655,586	570,131	634,869	676,486	657,098	877,133	868,651	841,752	709,137
Brunei	473,010	488,777	488,777	456,576	487,661	471,540	487,940	472,200	487,940	487,940	472,200	472,200
Great Germany: Old Reich	368,820	381,114	381,114	360,383	386,508	371,610	384,183	371,790	384,183	384,183	380,000	380,000
Ostmark	56,970	58,869	58,869	57,072	61,721	61,230	61,194	59,220	61,194	61,194	59,200	59,200
Slovakia and Moravia	9,810	10,137	10,137	9,454	10,106	9,780	10,106	9,780	10,106	10,106	9,800	9,800
Poland	320,370	331,049	331,049	310,155	331,669	320,790	331,421	320,730	331,421	331,421	320,700	320,700
Japan	224,494	223,960	225,308	210,801	224,068	216,960	224,719	217,470	224,719	224,719	217,470	217,470
British India	213,270	228,281	197,532	180,351	189,999	180,090	191,611	185,430	191,611	191,611	185,400	185,400
Ecuador	196,808	205,138	204,509	188,024	211,610	208,513	213,000	201,650	207,700	210,676	208,399	226,142
Saudi Arabia	313,757	437,020	491,663	323,416	606,201	476,359	334,728	356,571	478,243	425,829	467,900	467,900
Sarawak	109,080	112,716	112,716	104,951	112,282	108,330	112,282	108,660	112,282	112,282	108,700	108,700
Egypt	434,174	446,846	438,367	376,043	432,729	454,260	435,891	421,830	450,000	450,000	425,000	425,000
Italian Empire: Albania	114,540	118,358	118,358	112,230	123,411	119,250	121,241	117,330	121,241	121,241	117,300	117,300
Italy	7,500	7,000	6,650	6,000	5,500	5,000	5,000	4,400	4,400	4,400	4,000	4,000
France	41,160	42,532	42,532	39,817	42,439	41,100	42,470	41,100	42,470	42,470	41,100	41,000
Hungary	80,000	85,000	90,000	100,000	110,000	120,000	135,000	150,000	160,000	170,000	180,000	180,000
Bolivia	8,280	8,556	8,556	7,975	8,587	8,310	9,000	9,500	8,556	10,000	10,000	10,000
Other Countries	47,490	49,073	49,073	45,849	49,786	48,150	49,383	47,790	49,383	49,383	47,800	47,800
WORLD TOTAL	179,195,323	182,391,068	179,908,310	171,432,573	187,664,309	183,713,604	188,713,241	181,803,134	181,369,990	177,572,213	174,441,311	171,849,100

Where official figures are unobtainable because of existing conditions estimates based on best available private information are given.

Daily Averages in Barrels

	Jan.—October 1940	1939
United States	3,701,264	3,414,000
Soviet Union	598,882	593,772
Venezuela	519,110	569,247
Iran	216,027	214,113
Netherland India: Sumatra	111,506	113,486
Borneo	35,680	35,791
Java	17,922	17,715
Molucca and Other	2,010	2,311
Rumania	122,358	126,140
Mexico	109,753	106,103
Iraq	77,463	84,359
Colombia	71,929	60,020
Trinidad	54,487	52,795
Argentine	55,331	50,330
Peru	36,765	37,227
Bahrein	20,033	21,025
Burma	21,848	21,089
Canada	22,877	21,721
Brunei	15,688	15,767
Great Germany: Old Reich	12,406	12,294
Ostmark	1,974	1,899
Slovakia and Moravia	326	327
Poland	10,691	10,679
Japan	7,225	7,251
British India	6,181	6,220
Ecuador	6,820	6,283
Saudi Arabia	14,520	10,470
Sarawak	3,610	3,636
Egypt	14,175	12,245
Italian Empire: Albania	3,911	3,818
Italy	161	250
France	1,370	1,372
Hungary	4,573	2,139
Bolivia	293	276
Other Countries	1,588	1,583
WORLD TOTAL	5,896,616	638,561

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Barrels

	1939	1938	1937	1936	1935	1934	1933
United States	1,264,962,000	1,214,355,000	1,279,160,000	1,098,516,000	996,596,000	908,065,000	905,656,000
Soviet Union	216,727,024	206.192,000	201,856,661	199,635,921	184,008,033	175,635,783	155,596,429
Venezuela	205,783,585	188,429,050	187,675,477	155,270,840	148,809,057	136,098,681	117,113,940
Iran	78,151,332	78,320,840	78,109,001	62,977,950	57,520,488	57,902,092	54,440,075
Netherland India: Sumatra	41,557,020	34,538,128	33,451,511	30,469,428	28,004,595	26,336,011	22,345,172
Borneo	13,125,425	12,812,383	12,960,072	13,068,910	13,529,185	14,335,543	15,003,175
Java	6,568,660	6,955,283	7,152,931	3,618,293	3,462,440	3,778,920	3,600,816
Molucca and Other	836,144	607,622	537,436	375,823	311,872	273,698	285,335
Rumania	45,931,846	48,366,000	52,395,725	63,532,846	61,270,072	61,849,306	53,919,708
Mexico	39,428,141	38,505,824	46,455,687	41,027,915	40,240,563	38,171,946	34,000,830
Iraq	30,791,132	32,404,000	30,603,660	29,913,150	27,410,983	7,639,84	1,094,915
Colombia	22,036,613	21,581,588	20,297,543	18,756,110	17,597,655	17,337,900	13,156,126
Trinidad	19,270,256	17,736,176	15,502,989	13,237,030	11,671,224	10,894,363	9,561,353
Argentine	18,613,167	17,076,237	16,354,717	15,457,960	14,297,025	14,021,901	13,690,556
Peru	13,587,906	15,908,279	17,459,112	17,593,069	17,056,555	16,314,381	13,257,310
Bahrein	7,588,554	8,297,998	7,762,264	4,644,635	1,264,807	285,072	31,377
Burma	7,872,981	7,499,498	7,847,553	7,587,718	7,181,113	7,278,859	7,114,311
Canada	7,837,503	6,965,457	2,996,033	1,507,931	1,447,204	1,410,895	1,145,333
Brunei	5,755,164	5,387,214	4,397,038	3,296,938	3,302,905	2,705,350	2,035,656
Great Germany: Old Reich	4,487,491	3,850,044	3,148,300	3,076,858	2,967,438	2,204,402	1,656,902
Ostmark	693,247	370,038	221,266	50,092	44,347	27,965	5,765
Slovakia and Moravia	119,380	132,005	123,474	126,603	136,580	177,797	121,695
Poland	3,898,044	3,828,438	3,799,862	3,869,575	3,901,881	4,011,336	4,174,079
Japan	2,652,930	2,511,184	2,487,841	2,403,072	2,294,878	1,872,837	1,504,412
British India	2,332,467	2,330,209	2,161,653	1,978,329	2,037,810	1,921,863	1,628,803
Ecuador	2,312,118	2,257,278	2,161,436	1,942,467	1,731,785	1,636,619	1,619,902
Saudi Arabia	3,933,904	495,135	64,968	19,777	Nil	Nil	Nil
Sarawak	1,327,327	1,624,882	1,655,565	1,547,882	1,776,593	1,942,591	2,206,815
Egypt	4,602,797	1,561,231	1,163,267	1,262,666	1,255,151	1,527,252	1,653,535
Italian Empire: Albania	1,393,727	437,597	380,292	219,693	41,218	17,500	11,437
Italy	91,330	106,083	112,700	129,653	128,615	162,449	213,534
France	500,815	516,240	507,067	534,063	529,664	700,000	786,366
Hungary	769,092	330,829	13,910	100	Nil	Nil	Nil
Bolivia	100,885	106,620	123,123	104,746	163,295	157,875	111,973
Other Countries	578,036	243,000	70,000	37,100	32,300	64,000	54,100
WORLD TOTAL	2,076,218,043	1,982,639,390	2,041,170,134	1,797,791,150	1,652,023,331	1,516,760,036	1,438,797,443

PRODUCTION

—Conversion ratios used are weighted averages for individual countries

METRIC TONS

	Nov. 1939	Dec. 1939	Jan. 1940	Feb. 1940	March 1940	April 1940	May 1940	June 1940	July 1940	August 1940	Sept. 1940	Preliminary Figures Oct. 1940
United States	15,138,276	15,575,700	15,307,901	14,702,854	16,246,164	15,700,987	16,003,653	15,111,622	15,321,877	14,953,727	14,793,266	14,595,859
Soviet Union	2,427,120	2,508,024	2,508,024	2,360,194	2,531,522	2,436,780	2,520,083	2,503,429	2,530,864	2,537,722	2,537,722	2,537,720
Venezuela	2,476,894	2,383,153	2,197,278	2,135,135	2,303,632	2,449,294	2,723,594	2,766,089	2,461,786	2,247,159	2,171,217	2,053,170
Iran	852,090	880,493	880,493	826,152	894,753	863,190	870,212	855,540	884,058	888,784	888,784	888,785
Netherland India: Sumatra	438,803	464,685	444,602	403,218	440,506	438,960	432,525	426,270	440,479	440,479	426,270	426,300
Borneo	136,775	139,126	140,026	135,989	140,509	136,290	141,608	137,040	141,608	141,608	137,040	137,000
Java	70,404	81,057	71,830	64,935	72,035	68,820	71,114	69,210	71,114	71,114	69,210	69,200
Molucca and Other	7,981	7,752	7,581	7,981	6,916	8,670	7,967	7,710	7,967	7,967	7,710	7,700
Rumania	507,531	520,970	513,479	487,578	517,770	599,691	519,354	499,338	516,957	524,193	457,358	424,342
Mexico	543,318	513,950	492,094	462,171	482,525	466,960	501,028	491,923	432,452	500,734	499,265	509,838
Iraq	338,280	349,556	349,556	330,034	356,531	344,670	353,741	342,330	294,000	267,000	200,000	200,000
Colombia	267,627	260,524	346,499	282,512	307,290	305,745	338,493	306,834	306,834	306,834	278,940	278,940
Trinidad	222,780	230,206	230,206	215,151	229,710	222,360	229,896	233,300	236,800	240,000	246,000	253,165
Argentine	231,043	240,900	238,088	218,726	239,605	230,223	239,977	238,937	251,026	248,795	254,273	236,457
Peru	147,810	152,737	152,737	141,810	150,784	145,200	151,280	146,400	151,280	151,280	146,400	146,400
Bahrein	76,963	86,375	86,195	79,319	87,017	79,022	84,084	82,227	84,673	84,940	81,730	84,754
Burma	104,112	97,797	92,101	86,855	94,147	91,980	93,527	90,510	93,527	93,527	90,510	90,500
Canada	93,052	64,001	61,957	83,429	72,554	80,792	86,088	83,621	111,619	110,543	107,120	90,241
Brunei	63,090	65,193	65,193	60,900	65,038	62,880	65,069	62,970	65,038	65,038	62,970	62,970
Great Germany: Old Reich	53,190	54,963	54,963	51,997	55,800	53,940	55,490	53,700	55,490	55,490	53,700	54,340
Ostmark	9,030	9,331	9,331	9,048	9,827	9,780	9,703	9,390	9,703	9,703	9,390	9,390
Slovakia and Moravia	1,470	1,519	1,519	1,421	1,519	1,470	1,519	1,470	1,519	1,519	1,470	1,470
Poland	42,960	44,392	44,392	41,644	44,516	43,050	44,454	43,020	44,454	44,454	43,000	43,000
Japan	31,933	31,857	32,178	30,131	32,023	31,020	32,085	31,050	32,085	32,085	31,000	31,000
British India	29,457	31,530	27,280	24,911	26,226	24,870	26,443	25,590	26,443	26,443	25,590	25,600
Ecuador	25,947	27,045	26,962	24,788	27,898	27,490	28,081	26,585	27,382	27,775	27,475	29,814
Saudi Arabia	42,503	59,201	66,604	43,812	82,120	64,531	45,344	48,304	64,785	57,685	63,400	63,400
Sarawak	14,070	14,539	14,539[1]	13,543	14,415	13,920	14,446	13,980	14,446	14,446	14,000	14,000
Egypt	62,150	63,817	62,606	53,534	58,125	57,150	59,272	57,360	64,267	64,267	60,696	60,696
Italian Empire: Albania	17,100	17,670	17,670	16,762	18,415	17,790	18,073	17,790	18,073	18,104	17,790	17,790
Italy	930	870	820	750	680	620	620	540	540	540	500	500
France	5,760	5,952	5,952	5,568	5,952	5,760	5,952	5,760	5,952	5,952	5,760	5,760
Hungary	10,760	11,435	12,100	13,450	14,800	16,140	18,160	20,180	21,525	22,870	24,200	24,200
Bolivia	960	992	992	928	992	960	992	1,166	1,231	1,394	1,394	1,400
Other Countries	6,750	6,975	6,975	6,525	7,006	6,780	7,223	6,810	7,223	7,037	6,800	6,800
WORLD TOTAL	24,498,919	25,004,287	24,570,723	23,423,755	25,639,322	25,107,785	25,801,150	24,817,915	24,799,077	24,271,208	23,841,950	23,482,701

Daily Averages in Metric Tons

	Jan.—October 1940	1939
United States	500,780	461,913
Soviet Union	81,980	80,904
Venezuela	77,076	84,433
Iran	28,658	28,403
Netherland India: Sumatra	10,883	14,529
Borneo	4,553	4,604
Java	2,290	2,268
Molucca and Other	257	301
Rumania	16,591	17,103
Mexico	15,865	15,580
Iraq	9,960	11,276
Colombia	10,029	8,353
Trinidad	7,660	7 426
Argentine	7,856	7,166
Peru	4,864	4,927
Bahrein	2,733	2,862
Burma	3,007	2,912
Canada	2,911	2,764
Brunei	2,092	2,103
Great Germany: Old Reich	1,786	1,774
Ostmark	313	301
Slovakia and Moravia	49	49
Poland	1,429	1,432
Japan	1,031	1,037
British India	830	859
Ecuador	889	834
Saudi Arabia	1,967	1,429
Sarawak	464	469
Egypt	1,960	1,748
Italian Empire: Albania	584	470
Italy	20	31
France	192	192
Hungary	615	287
Bolivia	37	33
Other Countries	227	224
WORLD TOTAL	805,756	771,012

Official Crude Oil Production Figures for 1933 to 1939 (Revised) in Metric Tons

	1939	1938	1937	1936	1935	1934	1933
United States	171,148,965	164,346,325	172,822,797	148,707,864	134,912,143	122,913,903	122,601,191
Soviet Union	29,530,168	28,859,000	27,867,025‡	27,384,900	25,241,100	24,092,700	21,330,100
Venezuela	30,533,706	27,845,286	27,733,926	22,945,299	21,990,373	20,112,115	17,293,193
Iran	10,367,112	10,358,495	10,330,480	8,329,289	7,607,500	7,657,970	7,200,093
Netherland India: Sumatra	5,320,320	4,662,836	4,490,137	4,114,710	3,759,006	3,535,035	2,999,352
Borneo	1,680,377	1,719,783	1,739,607	1,773,545	1,815,998	1,924,234	2,013,849
Java	840,950	933,595	960,125	499,097	464,757	510,320	483,331
Molucca and Other	107,047	81,560	72.139	50,446	41,862	36 738	38,300
Rumania	6,228,047	6,603,000	7,153,000	8,704,000	8,394,000	8,473,355	7,387,000
Mexico	5,794,215	5,716,423	6,896,657	6,090,842	5,973,955	5,666,857	5,049,109
Iraq	4,115,845	4,345,000	4,126,185	4,079,066	3,724,231	1,048,108	147,943
Colombia	3,067,568	3,007,935	2,844,251	2,614,092	2,452,635	2,416,432	1,833,606
Trinidad	2,710,515	2,472,943	2,181,676	1,862,796	1,642,446	1,533,122	1,345,532
Argentina	2,651,448	2,432,857	2,330,063	2,202,304	2,036,903	1,997,706	1,950,499
Peru	1,798,557	9,099,885	2,313,691	2,331,454	2,260,903	2,161,990	1,756,867
Bahrein	1,033,472	1,130,734	1,058,557	635,555	173,072	39,008	4,293
Burma	1,087,424	1,039,960	1,083,391	1,047,593	991,456	1,004,951	982,233
Canada	997,391	879,921	378,478	190,495	182,820	178,233	144,686
Brunei	767,700	707,123	576,545	470,991	471,842	386,478	290,808
Great Germany: Old Reich	647,337	552,074	453,451	444,600	427,400	317,500	238,600
Ostmark	109,904	63,468	33,010	7,473	6,616	4,172	860
Slovakia and Moravia	18,103	19,282	18,036	18,665	19,946	25,971	17,776
Poland	522,874	504,678	501,301	510,630	614,760	529,200	550,670
Japan	379,161	356,328	341,040	341,976	326,580	266,520	212,667
British India	322,160	322,125	298,450	273,137	281,072	265,341	224,879
Ecuador	306,824	319,877	306,326	275,293	245,434	231,947	229,578
Saudi Arabia	536,366	66,683	8,070	2,447	Nil	Nil	Nil
Sarawak	171,322	200,126	217,085	221,126	253,799	277,513	315,259
Egypt	657,510	223,058	166,298	177,491	176,436	214,671	232,437
Italian Empire: Albania	208,279	65,313	56,760	32,760	6,152	2,500	1,707
Italy	11,346	13,178	14,000	16,106	15,977	20,180	26,526
France	70,224	72,106	71,008	74,788	74,172	98,025	110,120
Hungary	103,364	42,798	13,910	13	Nil	Nil	Nil
Bolivia	11,904	13,262	15,487	13,197	20,540	19,858	14,085
Other Countries	82,300	34,080	10,000	5,300	4,600	9,100	7,700
WORLD TOTAL	283,939,805	279,111,097	279,482,962	246,449,340	226,610,486	207,971,753	197,034,849

WORLD PETROLEUM ABSTRACTS

Summaries of the Most Important Articles as Published in the Oil Press of the World Dealing With Technical and Economic Aspects of the Petroleum Industry, Edited by Dr. O. W. Willcox

GEOPHYSICS

Electrical Methods of Geophysical Exploration—H. M. Evjen, in GEOLOGIE MIJNBOUW, n. s. Vol. 1 (1939), pp. 2-8; Geophys. Abs., 97, 64.

A discussion is given in defense of the electrical method of prospecting, which has been neglected since the early days of electrical methods, when ignorance, wishful thinking, and extravagant claims were so manifest.

The difference between seismic and electrical exploration, especially regarding the question why one should have become a big success and the other a comparative failure, is explained as follows: Both are based in the final analysis on wave equations—one on the wave equation of elasticity; the other on that of electro-magnetism. Theoretical possibilities of the two methods are much the same, and there is a close parallelism between the two, except in one respect—electric equations permit conduction currents. The seismic analogue to this would be an inelastic transport of mass particles through the medium. The comparative absence of this phenomenon accounts for the comparative absence of absorption in seismic waves. Thus it permits the use of much shorter wave lengths, with consequent improvement in resolving power; but, most important, it permits the theory of interpretation to be reduced to that of geometrical optics. That is, it reduces the theory to the high-school stage and makes it available for the practical man. A reduction to simple terms is not possible in electric methods because of the phenomenon of absorption. Here the problem is one of physical rather than geometrical optics. The practical man therefore has difficulty in understanding the theory and cannot apply himself intelligently to the improvement of the technique. The theoretical man, on the other hand, who thoroughly understands the principles involved as a rule does not have much practical ability or inclination to apply his knowledge. This is probably the fundamental reason for the comparative failure of the electrical method.

Radioactivity of Sedimentary Rocks and Associated Petroleum—K. G. Bell, Clark Goodman and W. L. Whitehead, in BULLETIN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 9, pp. 1529-1547.

Determinations of the radioactivity of 21 sedimentary rocks and 7 associated crude oils have been made by the precision method developed by R. D. Evans. The specimens consisted of cuttings and cores from wells in the Bartlesville, Cromwell, Frio, Woodbine, and Viola-Simpson formations. Considerable variability in radioactivity was found in the sandstones (1.4 to 0.19×10^{-12} gms. Ra/gm.) and limestones (1.3 to 0.18×10^{-12} gms. Ra/gm.). The radium content of limestones decreases with increasing purity. The shales were uniform (1.2 to 1.0×10^{-12} gms. Ra/gm.). Apparently, discrete mineral particles in sandstone and impurities in limestone account for their occasional high radioactivity. The radon content of the crude oils (0.47 to 0.05×10^{-12} curies/gm. of oil) was in one sample 38 times, and averaged 10 times, the amount in equilibrium with the radium present. The results corroborate the inferences of former investigators that radon tends to concentrate in crude oils. Maximum radon content and maximum ratio of radon to radium were found in petroleum produced from a permeable, Oligocene (Frio) sandstone of high radioactivity. Cracking of hydrocarbons with generation of hydrogen has been proved by S. C. Lind to result from bombardment, with alpha rays. The amounts of radioactivity found in these crude oils are quantitatively sufficient to cause appreciable cracking by alpha radiation during geologic time. These reactions, together with subsequent hydrogenation, may account for important changes in petroleum. This hypothesis would also explain the presence of hydrogen in some natural gases. The hydrogen content of soil gases is suggested as a possible method of geochemical prospecting for oil fields.

GEOLOGY

Oil Field Waters of Wyoming—James G. Crawford in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 7, pp. 1214–1329.

The chemical laboratory of the U. S. Geological Survey at Midwest, Wyo., has analyzed, classified and correlated more than 3,000 water samples from oil and gas zones in the Rocky Mountain region. In the majority of cases these analyses have permitted geological correlations and it is not unusual to identify by the similarity of waters, lithologic units in wildcat wells many miles from producing fields. Such identifications have often meant considerable time and money for oil and gas operators.

An important point in a study of oilfield waters is concentration, a factor that is controlled chiefly by the physical characteristics of the strata. Where the structure prevents free circulation of ground water, the formation water is more concentrated, but where circulation is relatively free, the formation water is dilute and of substantially the same character as that entering the sand at the outcrop. Concentration is thus a measure of water movement in the structure, and consequently a closed structure capable of retaining oil and gas contains a more concentrated water. A dilute water generally indicates a freedom of flow sufficient to have flushed oil and gas from a structure.

It would therefore be expected that the concentration of formation water would increase updip and reach its maximum at the oil-water contact. From the foregoing reasoning, it is suggested that the concentration and chloride content of formation waters is not a function of depth but rather of the water movement in the sand, and will reach its maximum at or near the oil-water contact.

Instances of increase in concentration and salinity at the oil-water contact are found in several oil-producing fields in the state, the First Wall Creek sand water of the Salt Creek field being a good example, but there is not as yet sufficient evidence to draw general conclusions. The writer suggests, though, that such increase in concentration and salinity will be found in the Cretaceous, and probably Jurassic, waters of the state, whereas the secondary saline waters of the pre-Chug-water beds will not show this characteristic, to any marked extent.

Critical Survey of Recent Developments in Geochemical Prospecting—Sylvain J. Person, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 8, pp. 1464-1474.

A critical study of the respective advantages and disadvantages of the two current geochemical prospecting procedures is presented. It is particularly pointed out that soil analysis has only as advantage a relatively simple field procedure but in view of the complexity of the material analyzed, it is difficult, if not impossible, to reduce results to a common basis of comparison. Further limitations placed on soil-analysis prospecting are the persistence of the halo patterns and the shielding effect of shallow beds bearing oil and/or gas. Soil-air sampling is not affected by these limitations to as high a degree as soil sampling and it is therefore recommended that it should be given further serious trials regardless of the fact that it requires a more complex field procedure.

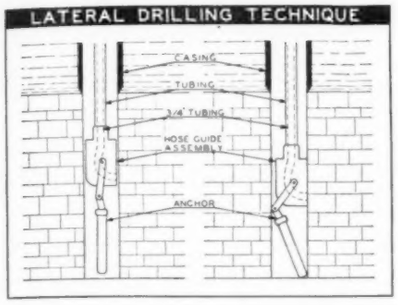
DRILLING

Chemical Engineering in Petroleum Exploration and Production—P. E. Fitzgerald, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 8, pp. 1361-1369.

Aside from various particulars regarding the use of chemicals in oil wells, the author directs attention to the possibilities of chemicals as a means of drilling horizontal holes in deeply buried oil-producing formations. There has been developed a horizontal drilling device which utilizes a flexible armored hose, hose guide, and suitable jets. See accompanying figure. The hose with a jet on the bottom end is lowered into the well on a string of small tubing; this assembly is introduced into the well through the conventional tubing string which has the hose guide at its lower end. The small pipe is attached to a weight indicator which provides a means of controlling the contact pressure of the jet against the forma-

tion. Chemicals capable of solvent action are pumped through the small tubing and thence through the jet against the formation. The combination solvent and jetting action drills a hole into the formation.

This tool has been used experimentally in several areas, and in Kansas a hole was drilled laterally a distance of 40 feet into the Kansas City formation.



Some of the factors to be considered if this type of drilling becomes practical are its effect upon well spacing, ultimate recovery, and possibly proration. There is no doubt that such a well-completion method would permit a more efficient use of available reservoir energy by reducing the pressure differential necessary to cause flow of oil into the well. By drilling several holes laterally a distance of about 10 feet the oil can be produced with probably one-half the pressure differential drop since it has been proved experimentally by Uren and theoretically by Muskat that about 50 percent or more of the available energy is dissipated within 10 feet of the well.

If these horizontal holes are drilled in formations that lend themselves to chemical treatments, the pressure differential will be reduced still more, allowing for a more efficient use of the available reservoir energy.

High-Pressure Salt-Water Flow Overcome—M. L. Cashion, in PETROLEUM ENGINEER, Vol. 11 (1940), No. 12, pp. 90-97.

When a drilling well encounters high-pressure salt water flows, it usually means abandonment of the operation if only orthodox methods are employed in an effort to combat such flows. Because this obstacle has been the direct cause of discontinuing many tests that might otherwise have proved productive, and because in the deep tests of the Gulf Coast and elsewhere salt water under high pressure is sure to be encountered, more than ordinary importance is attached to the procedure by which a strong salt water flow in a Gulf Coast well was successfully combatted.

The well in question was scheduled to be sunk to a depth of 12,000 feet under Lake Borgne in Louisiana, where 20 previous tests had failed to cope with the salt water flows always encountered under excessive pressure at depths of about 10,000 feet. As expected, the high pressure salt water was encountered at 10,630 feet. The arrangements for coping with it related mainly to pressure drilling equipment, and to mud treatment. It is emphasized that no essentially new equipment was used, but great care was used in selecting the various items and gaining familiarity with their function and use. (The inference is that drillers who have been beaten out by these deep salt flows were defeated because they had not sufficiently prepared and studied their equipment and organized their programs for meeting contingencies.—Ed.)

The more important elements of the plan for installing pressure drilling equipment were as follows:

1. Hydraulic feed rotary (including snubbing equipment).
2. Pressure control equipment on the wellhead.
3. Chokes on the mud return lines.
4. Back-pressure valves, etc., in the drill string.
5. External-flush drill pipe (to permit going in and out of the hole through the drilling packer under pressure).

Previous experience has shown that normal water-mixed mud, even when heavily weighted, was inadequate for resisting the high pressure of the salt water. A principal difficulty was the flocculating action of the salt on the colloidal materials of the mud. A special drilling mud was invented, using silicate of soda. This ingredient has frequently been used to combat heaving shale, but it appears that this is the first instance of its use to counteract the effect of high-pressure salt flows. Among other desirable qualities, it is very resistant to the effects of high bottom-hole temperatures (285 deg. F.) The silicate mud (16-lbs. per gal.) did not thicken under these conditions. The silicate of soda base mud used at Lake Borgne has for its fluid phase one-third by volume of a saturated sodium chloride (common salt) and two-thirds of a special silicate of soda preparation.

OPERATION

Recycling Not Limited to Large Properties. Way C. Fish, in PETROLEUM ENGINEER, Vol. 11 (1940), No. 12, pp. 99-102.

The author describes a plant in the Cayuga field Anderson County, Texas, which was designed to produce 200 bbl. of distillate a day, which is recovered from the gas by low-temperature (0 deg. F.) equilibrium separation. Gas-handling capacity was designed to handle 10,000,000 cu. ft. per day at a plant intake pressure of 1,000 to 1,200 lbs. and a formation injection pressure of 1,600 lbs. An angle type compressor performs both the compressing and refrigeration duties. Refrigeration is by ammonia, and dehydration by calcium chloride. The distillate is weathered in three stages for rejection of methane and ethane. Four wells supply gas to the plant, one from the Trinity and the three others from the Boyer sand of the Woodbine; the latter produce some oil with the gas.

Pressure Distribution About a Slotted Liner in a Producing Oil Well—Frank G. Miller, in PETROLEUM TECHNOLOGY, Technical Publication No. 1222; August, 1940; 15 pages.

The laboratory investigation described herein was made to determine the effect of a slotted liner on the pressure gradient in the vicinity of the wall of a flowing well. Flow restrictions caused by the liner induce energy losses between the oil-bearing formation and the inside of the liner, which may be reduced by improved liner design, and thereby the flow capacity of wells may be increased. These losses have been evaluated for rectangular slots of different sizes, and means are suggested for reducing them.

The most important results of the investigation appear to be the following.

1. The additional pressure loss resulting from the formation of a sand bridge over a rectangular slot becomes small, nil, or even negative if the slot width used is equivalent to at least twice the grain size at the 10-percentile size of the sand, taken from its sieve-analysis curve. The pressure loss resulting from the bridge increases markedly when the slot width is reduced.

2. The additional pressure loss resulting from the convergence or crowding of the streamlines in the sand near a slot decreases as the slot length is increased. Experimental results show that the additional presssure drop per unit rate of flow due to a slot of length equal to the sand thickness is about one-third the loss for a slot of the same width but only one-half the length, placed so that its center is midway between the upper and lower horizons defining the oil-bearing sand, if the effect of bridging is neglected. Increasing the width of the slots without increasing the length does not reduce the convergence loss greatly.

3. The pressure loss due to the slots alone, which is similar to the pressure drop across an orifice in pipe-line flow of fluids, is small compared with the corresponding loss that would occur in the sand near the slot.

Major Economics from Twenty-Acre Well Spacing in Western Kansas—Joseph A. Kornfeld, in OIL WEEKLY, Vol. 98 (1940), No. 13, pp. 10-14.

Twenty-acre spacing was first applied in western Kansas two years ago and is the pattern employed in more than one-fifth of the proratable wells now producing on the Central Kansas uplift; two out of every three new wells are now staked on that plan. It is estimated that this has saved the region more than $16,000,000 in development costs, and due to the assured greater recovery has added 107,250,000 barrels to the reserves. The 20-acre pattern is the minimum; wider spacing may be indicated by local circumstances, but 40 acres is given as the maximum advised.

NATURAL GAS

Raising Absorption Efficiency by Pre-saturating Lean Oil—A. J. L. Hutchinson and Ernest Moncreif, in OIL AND GAS JOURNAL, Vol. 39 (1940), No. 13, pp. 53, 55.

Ever since the earliest days of absorption plants one of the problems confronting the designer as well as the operator has been the temperature rise of the absorption oil as it passes through the absorber. The effect of temperature rise is to give a higher temperature to the rich oil leaving the absorber and the higher this rich oil temperature the greater must be the oil circulation to accomplish the desired absorption. The selectivity of absorption becomes greater with a decrease in rich oil temperature, thereby enabling the absorption of the desired constituents without as large an absorption of "fixed gases."

A number of methods have been used in the past to reduce this high oil-outlet temperature; the two most commonly used being refrigeration either of the gas or oil or both, or by the use of either internal or external intercoolers. Either of these two methods will increase the absorption efficiency if properly applied.

However, the authors propose a third method, which consists of contacting in an absorber all the lean oil which is to pass through the main absorber with all of the plant bent gases, from which all the desired salable fractions have been removed. This contacting of the oil and vent gases is accomplished at as high a pressure as possible without the expenditure of excess horsepower. In most plants all the vent vapors can be

comingled at a high enough pressure so that no compression is required. With the high gas oil so obtained it is often possible to absorb all the butane, all the propane and considerable quantities of methane and ethane contained in the vent gases. The presaturated oil, heated by the latent heat and heat of solution of these constituents, is then cooled and pumped into the main absorbers.

The net overall result of the process can be summed up as follows:

First, a high extraction efficiency can be obtained in the main absorber, enabling a greater quantity of gas to be treated or allowing a reduction in the absorption oil circulation. Second, the volume of the residue gas from the main absorber is materially increased and the volume of the plant vent gases is reduced. Third, the high heating value fractions of the plant vent gases are made available for pipe-line sale. Fourth, the lean oil water content is reduced and the tendency for water to condense from the treated gas in the main absorber lessened.

Natural Gasoline Cuts and Their Relation to Aviation Gasoline—Karl Korpi, before CALIFORNIA NATURAL GASOLINE ASSOCIATION, Long Beach Meeting, 1940.

Natural gasoline has always been an important source of aircraft fuels because of its volatility, knock rating and good lead susceptibility. Even though the present trend in aviation gasolines is toward octane numbers that cannot be attained by natural gasoline, it still plays an important part as a source of raw materials and as a blending stock in the production of all grades of high antiknock rating fuels, including some of the super-octane number variety.

There are four types of aviation gasoline with knock exceeding 90 iso-octane that can be produced by suitabie blends of alkymer aviation, isopentane, iso-octane, neohexane and natural gasoline heart cuts.

These are characterized by the following specifications:

1. 92 octane number (Army) with not more than 3.4 ml. of tetraethyl lead (T. E. L.)/ gallon.
2. 92 octane number without lead.
3. 100 octane number (Army) with not more than 3 ml. T. E. L./gallon.
4. Octane numbers in excess of 100 iso-octane and equivalent to iso-octane plus 1.5 (110 octane) and 3.0 ml. T.E.L./gallon (115 octane).

All of these fuels must have vapor pressures not to exceed 7 lb./sq. in. at 100 deg. F. and Engler distillations not above 167 deg. F. at the 10 percent point, 212 deg. or 221 deg. F. at the 50 percent point (depending on the fuel) and 275 deg. F. at the 90 percent point.

The first of the above fuels can be made entirely of natural gasoline by separation of a suitable heart cut that has a suitable Engler distillation curve and a clear knock rating to give 92 octane (Army) with not more than 3.4 ml. of T. E. L. The others require certain proportions of special hydrocarbons, but in all of them the proportion of natural gasoline is substantial.

Experience with Underground Storage of Gas. E. O. Schillhahn and F. H. Finn, in BULLETIN AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS, Vol. 24 (1940), No. 8, pp. 1478-1494.

In these two separate papers the authors describe the use of more or less depleted sands for the underground storage of both artificial and natural gas. The experience of Mr. Schillhahn relates to two fields in southwestern Pennsylvania and although this experience has been limited, especially in relation to extended withdrawal periods, the value of these two underground storage fields in creating additional available gas for peak-load requirements seems well established. The fields are located along the main transmission lines and were used to good advantage this past winter. As a result of this experience with the underground storage of gas, it is planned to establish in the near future additional small storage fields at available strategic points along the main transmission lines.

The experience of Mr. Finn relates to storage of natural gas (from the Oriskany) in a large, nearly depleted section of the Murrysville sand (Grapeville anticline) in an area of about 2,780 acres. This large pool was quite satisfactory for the safe storage of a large amount of gas, but a satisfactory rock pressure could not be conveniently built up. This fact, together with failure of the previous large source of supply, led to the selection of a smaller pool (630 acres where it was found convenient to build up a pressure of 196 pounds, with a future intention of raising it to 500 lbs. An experiment with a small pool in the Farmington field was also very successful.

Storage has thus been found to be an excellent solution for the problem of peak loads, as the storage process can be accomplished at times when gas is not needed so badly for the markets, and withdrawal can be made at a rapid rate when market requirements are excessive. It may readily be seen that storage may be used as a stabilizer by permitting production from the active wells at a steady rate throughout the year, putting the gas in storage in summer and withdrawing the same gas in the winter when it is needed.

PHYSICS

Some Effects of Chemical Composition of Lubricants Operating In the Region of Boundary Lubrication—A. W. Burwell and J. A. Camelford, Alex Corp., Niagara Falls, N. Y. before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

Determinations are made of the force required to initiate motion in a bearing system at rest, under specified and controlled conditions of pressure, temperature, and lubricant compositions.

Since hydrodynamic lubrication is impossible in the system under these conditions, the factors involved in boundary lubrication may be studied, particularly the effects of small additions of substances frequently used to increase oiliness and film strength effects.

Results are given of determinations made upon lubricating oils blended with agents of the type described above, and comparisons made. The mechanism of the surface activities is briefly discussed.

Factors Influencing Permeability Measurements. Anders J. Carlson and Max C. Eastman, in PETROLEUM TECHNOLOGY, Vol. 3 (1940), No. 2, Technical Publication No. 1196, six pages.

Among the means employed in the evaluation of reservoir rocks core analysis holds first place, and among the physical data employed in this analysis permeability is of primary importance. For measuring permeability the air permeometer seems to fill most satisfactorily the need for rapid and fairly accurate determinations. However, instruments designed for the purpose have not given an encouraging uniformity in the results obtained.

The authors have devised and described an air permeometer and a method of using it which gives satisfactory agreement under proper operating conditions. It consists in fixing a cut sample of a core in a glass tube and forcing air through it under standardized conditions of pressure and temperature, which they fully describe. They have this to say about the operation:

The method of cutting the sample has no significant effect on the measured permeability value. Condition of the surfaces exposed to air flow is not as important as is generally supposed.

Mounting of the sample is important. The use of sealing wax gives consistent results. The use of rubber stoppers may result in appreciable discrepancies unless the core holder is particularly designed to prevent by-passing of air between sample and stopper.

It is probable that turbulent flow conditions are responsible for some discrepancies in permeability measurements now being carried on with similar instruments.

For the types of cores tested by the authors a tentative and approximate rule may be formulated: Turbulent conditions will be avoided if rate of flow through the sample is kept below 1 ml. per sec. per sq. cm., measured at the mean pressure through the sample.

Petroleum Equilibria—S. W. Ferris, The Atlantic Refining Company, Philadelphia, Penna., before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

Evidence is presented indicating (1) that, regardless of extreme variations in conditions, synthetic crudes resulting from pyrolytic treatment of petroleum or petroleum fractions approach a definite boiling range equilibrium; (2) that the same is true for many processes often considered radically different from ordinary pyrolysis; (3) that the synthetic crude may be made to depart from this equilibrium only by carrying the reaction to the point of severe hydrogen impoverishment, after which a second equilibrium is approached; (4) that natural crudes seek the same equilibrium.

The Number of Carbon Atoms in Naphthene Rings Calculated from Density—M. R. Lipkin and S. S. Kurtz, Jr., Sun Oil Company, Marcus Hook, Penna., before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

Densities for pure compounds containing three and four rings per molecule of either the cyclopentane or cyclo-hextane type are shown to agree with the curves of Kurtz and Lipkin relating density to molecular weight and ring structure. For groups of similar compounds these average pure compound data agree within ±0.2 carbon atom per ring.

Examination of data published by A. P. I. Project 6 shows that the average number of carbon atoms per ring is the same in the SO_3 insoluble water white oil and in the aromatic extracts. These data, as well as data of two foreign investigators, indicate an average of 5.4 ±0.1 carbon atoms per ring in lubricating oils.

Measurements of Vicosities of Oils Under Reservoir Conditions. C. R. Hocott and Stuart E. Buckley, in PETROLEUM TECHNOLOGY, Technical Publication No. 1220, August 1940, 6 pages.

A simple rolling-ball viscosimeter has been constructed, which has been used successfully for routine determinations of the viscosity of sub-

surface samples of oil at reservoir temperatures and pressures.

The instrument is adaptable to the measurement of a wide range of viscosities through positive variation of the roll angle, variation of the diameter of the barrel, and variation of the size of the ball.

It has been found, through examination of a large number of subsurface oil samples, that the viscosity of an oil is a minimum at the saturation pressure and that the release of dissolved gas attending reduction of the reservoir pressure results in increased viscosity of the residual oil. Because of the nature of the variations of the viscosity with pressure, direct measurements on subsurface samples appear to be the only feasible method for determining the viscosity of any particular oil under reservoir conditions.

CHEMISTRY

Action of Solutizers in Mercaptan Extraction—D. L. Yarbroff and E. R. White, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 7, pp. 950-953.

This is a contribution to the physico-chemical theory of the new "Solutizer" method of removing mercaptans from gasolines which promises to supplant or complement the classic doctor sweetening. The general result is that aqueous caustic solutions containing certain organic solvents or organic salts ("solutizers") are much better than straight aqueous caustic solutions for the extraction of mercaptans from gasolines. A study of the action of solutizers shows that, as expected from previous work, organic solvent solutizers increase the solubility of unneutralized mercaptan in the alkaline phase and thereby lead to more complete mercaptan removal from the oil phase. Organic salt solutizers, on the other hand, exert a salting-out effect on the unneutralized mercaptan at low solutizer concentrations, but this effect is reversed at the higher solutizer concentrations. In addition, both types of solutizers appear to eliminate largely the marked salting-out effect of the sodium hydroxide itself which was previouslv observed with unsolutized caustic solutions.

The organic salt solutizer that seems best indicated for commercial operations is sodium isobutyrate.

Determination of Unsaturation in Aliphatic Hydrocarbon Mixtures by Bromine Absorption—J. B. Lewis and R. B. Bradstreet, in INDUSTRIAL ENGINEERING CHEMISTRY, Analytical Ed., Vol. 12 (1940), No. 7, pp. 387-390.

The method commonly used for determining the amount of unsaturated hydrocarbons in gasoline or other light petroleum fraction requires a trial titration with iodide and thiosulphate. The authors have found that a refinery chemist can do nearly twice as many gasoline samples a day if the trial titration is eliminated. They have therefore modified the Buc method, which as modified consists in treating the sample with an acid solution of potassium iodide with n-heptane as a diluent, titrating directly with 0.5 *N* potassium bromide-bromate solution in excess and back-titrating with potassium iodide and thiosulphate. It is unnecessary to use a cooling medium. Where certain sulphur compounds are present (mercaptans) their effect is neutralized by the addition of small amounts of catalysts such as silver bromide, uranium acetate, mercuric chloride and zinc sulphate. Where highly branched polymers are present the method gives erratic results, but for gasolines it has superseded all other methods in the laboratories of the Standard Oil Development Co.

A New Firing Time Test—Jack de Ment, in REFINER, Vol. 19 (1940), No. 8, pp. 70-72.

The author describes a simple test that seems to have a high specificity for many substances and capable of many uses. It consists of placing a measured quantity (1 ml.) of an inflammable material in a watch glass 7 cm. in diameter and 1.1 cm. high having a concave bottom; a match is applied to the liquid and the time required for complete combustion is noted with a stop watch. As stated, this test is highly specific and characteristics of a given sample, about which the phenomena of combustion and residue, if any, will often indicate much of interest. It may be applied to mixed liquids and solutions as well as to pure liquids. Among possible uses the author lists the following:

1. General application to laboratory operations requiring individualization of samples.
2. Standardization of base chemicals used in the various processes of the gasoline and petroleum industries.
3. Investigations into liquid fuels.
4. Establishing prerequisites for gasoline relative to uses in engines for special purposes.
5. Batch testing of oil samples.
6. Grading fractions as they are obtained from the towers.
7. Classifying crudes and residues.
8. Investigations into the smokiness of fuels.
9. Solvent refineries and paint work.
10. Waxes, asphaltum, tars, roofing and protective materials.
11. Flue gas testing.
12. Resins and similar materials.

Oxidation of Lubricating Oils. I. Apparatus and Analytical Methods—M. R. Fenske, C. E. Stevenson, R. A. Rusk, N. D. Lawson, M. R. Cannon, and E. F. Koch, Pennsylvania State College, before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

An apparatus and procedure are described which permit determination of the rate of lubricating oil oxidation. Studies are usually made over the range 130 deg. to 180 deg. C. using oxygen in a circulatory system. Methods have been developed for the determination of substantially all the volatile and nonvolatile end products of the reaction.

Ninety to one-hundred percent of the oxygen absorbed by various oils has been accounted for in the products determined. The chief product is water, which accounts for 40 to 60 percent of the reacting oxygen. Soluble saponifiable materials represent another considerable portion, while carbon dioxide, carbon monoxide, volatile acids, fixed acids, and precipitable products account for the remainder.

The analysis of insoluble materials produced by laboratory and engine oxidation indicates these to be relatively highly oxygenated materials (14 to 24 percent oxygen) produced by polymerization or condensation of the oxidized oil. Molecular weights and elementary analyses suggest certain empirical formulas for the insoluble bodies.

The oxidation of several commercial light oils shows the rates of oxidation to vary widely and that induction-type oxidation curves may be quite common. In general, these results show the widely different oxidation characteristics existing in oils, and that much of the oxidation mechanism remains to be understood before corrective measures are generally applicable.

Oxidation of Lubricating Oils. II. Factors Controlling Oxidation Stability—M. R. Fenske, C. E. Stevenson, N. D. Lawson, Glenn Herbolsheimer, and E. F. Koch, The Pennsylvania State College, before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, September, 1940.

A study of the oxygen absorption characteristics and the nature of the products obtained from oils oxidizing under controlled conditions has permitted the evaluation of a number of factors involved in lubricating oil deterioration. Investigation of selected fractions of a distillate stock has shown considerable variations in reactivity toward oxygen.

The rate of oxygen absorption approximately doubles for each 10 deg. C. temperature increase over the interval 140 deg. to 180 deg. C., providing it is not limited by physical factors.

The presence or absence of water vapor in the oxidizing atmosphere has little effect on the oxidation of one type of oil.

It has been found possible to reduce greatly the oxidation of certain oils by adding natural or synthetic inhibitors.

Clay treatment may either reduce or improve the stability of an oil, depending upon its nature.

Iron, copper, and lead are strong catalysts for oil oxidation when present either in metallic form or as naphthenate salts.

Certain types of oils have a natural ability to counteract the catalytic effect of dissolved iron salts.

The use of a phosphite additive has been found to control or eliminate catalysis by certain iron, copper, or lead salts, but such additions are frequently accompanied by other changes in the oils, so that the over-all effect is more complex than simply a reduced degree of oxidation.

Addition agents are capable of making marked changes in the degree of oxidation occurring in oils. They may also influence the direction and character of other accompanying reactions, such as polymerization, condensation, decarboxylation, dehydration, etc., with the result that many of the oxidation products may now be affected independently of the overall degree of oxidation. In general, addition agents must be studied thoroughly and in detail in order to understand all the changes that are induced by their presence.

Recovery of Sulfur Dioxide from Waste Gases—H. F. Johnstone and A. D. Singh, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 8, pp. 1037-1049.

A new process for the regeneration of sulfite-bisulfite solutions used for absorbing sulfur dioxide from waste gases is described. It is based on the precipitation of zinc sulfite, followed by decomposition of the dried solid in a flash calciner to give pure sulfur dioxide and zinc oxide, the latter being recycled. A thorough study in the laboratory and pilot plant has given important information on several of the unit operations.

The total annual production of sulfur dioxide in the United States is now about 12,000 tons and there are possibilities of developing new uses. Cheap sulfur dioxide can displace sulfur in the paper industry. Of special interest are the new sulfur dioxide-olefin resins containing nearly 50 percent sulfur dioxide produced by reaction of liquid sulfur dioxide with certain waste refinery

gases. These resins are thermoplastic, moldable, acidproof, and stable up to 300 deg. C., and have high dielectric strength. Because of the nature of their ingredients they are among the cheapest of the purely synthetic fabricating materials. Other possibilities include new uses of sulfur dioxide in certain metallurgical processes and as a raw material for heavy chemicals.

Octane Rating Relationships of Aliphatic, Alicyclic, Mononuclear Aromatic Hydrocarbons, Alcohols, and Ketones—Gustav Egloff and P. M. Van Arsdell, Universal Oil Products Company, Research Laboratories, Chicago, Ill., before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

No single standardized motor test method evaluates the nondetonating properties of organic substances in an automobile engine. A correlation of structure with octane rating has been attempted under research and motor method conditions. using pure aliphatics, alicyclics, alcohols, and ketones, and a blend of mononuclear aromatic s This study indicates, in part, that for all groups the longer the straight chain part of the molecule, the lower the octane rating.

The tertiary carbon atom also seems to have considerable influence on the nondetonating quality of the hydrocarbon and may be roughly correlated with the influence of the olefin double bond, since as both converge on the center of the molecule the octane rating is raised.

A quaternary carbon if oriented near one end of a paraffin chain also has a great effect in increasing the nondetonating characteristics.

Separation and Composition of a Lubricating Oil Distillate—M. R. Fenske and R. E. Hersh, The Pennsylvania State College, State College, Penna., before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

The systematic separation of a lubricating oil distillate by selective solvent extraction and fractional distillation into portions comprising 0.6 to 1.4 weight percent of the original oil allowed the construction of three-dimensional diagrams incorporating yield, viscosity index, and molecular weight or viscosity. Such diagrams permit an estimation of the distribution of oil fractions with respect to molecular size and molecular type. Used in connection with graphs of boiling point and aniline point isotherms superimposed on the composition diagram, methods for the segregation of any portion of the oil are suggested.

Comparison of the physical properties of the fractions with those of synthetic hydrocarbons indicates that the oil fractions, while perhaps far from being separated into pure compounds, are segregated into groups ranging from monocyclic naphthenes (C_nH_{2n}) to polycyclic aromatics (C_nH_{2n-18}).

Spontaneous Ignition of Hydrocarbons and the Zones of Non-ignition—Charles W. Sortman, Harold A. Beatty, and S. D. Heron, Research Laboratories, Ethyl Gasoline Corp. before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

Spontaneous ignition temperatures in air, and the corresponding time lags, have been determined for a variety of hydrocarbons at atmospheric pressure by the oil-drop or Moore method, using a steel crucible and different airflow rates and liquid drop sizes. Under some conditions of air and liquid feed, the readily-ignited hydrocarbons, such as cetane and heptane, show distinctly two separate temperature zones of nonignition, above the minimum ignition temperature, a behavior heretofore unobserved; under other conditions, one or both of these zones are eliminated. The conditions of air and liquid feed also have a marked effect on the ignition time lag, especially at low temperatures. Addition of tetraethyllead completely inhibits ignition up to about 850 to 1000 deg. F.

Methods of Testing Fuel Oils for Cracked Products—A. S. Sainz, in INDUSTRIA Y QUIMICA, Vol. 3 (1940), No. 2, pp. 42-48.

The Oliensis spot test seems to be the best method of distinguishing a topped fuel oil from a cracked fuel and is employed in the laboratories of the Y. P. F., but it seems to be reliable only when the cracking has been rather intense, and has been carried to the point of forming carbonids. A mixture of cracked and topped fuels responds to the test only when the cracked product is present in an amount greater than 50 percent; the spot obtained from a 40 percent mixture is similar to that obtained from an unmixed topped fuel due to the presence of asphaltenes in the original crude. Cracked products from mixed base crudes respond to the test more readily than those from paraffin base crudes, which have to be intensely cracked in order to show the characteristic spot test.

Composition of Some Cracked and Polymerized Naphthas—R. E. Tannich, B. W. Thomas, and A. R. Padgett, Humble Oil and Refining Company, Baytown, Texas, before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

Three samples of refinery cracked naphthas representing the products of thermal cracking and polymerization processes were analyzed with the aid of a 115-plate batch laboratory column. The unsaturate contents of representative fractions of these naphthas and the quantities of certain paraffins and naphthenes present have been determined. Methods of analysis and representative examples are presented in detail. The concentration of unsaturates is shown to be greatest at split points between saturated compounds and in general to decrease with increasing boiling point of the cracked naphtha. The gasoline produced by thermal polymerization of propane and butanes shows a higher degree of unsaturation than does that produced by thermal cracking of heavy petroleum fractions such as gas oils and residuums.

REFINING

Volatility Decrease and Availability of High Knock Rating Aviation Fuels—D. P. Barnard and R. B. Cragin, before SOCIETY AUTOMOTIVE ENGINEERS, June, 1940.

As bearing on the question of supply of high grade aviation fuels the authors point to two significant facts, first, that with greater tolerances allowed for distillation range a marked increase in yield from crude supplies could be obtained, and secondly, that if aromatic fuels could be successfully used availability would be further augmented. It is true that there are an immense number of paraffinic compounds that would be suitable, if obtainable, but the fact is that in the present state of technology these products are inaccessible. Hence the easiest path (from the petroleum technologist's standpoint) to an expanded supply of aviation lies in the utilization of an enlarged supply of aromatics, of which the most likely source now appears to be catalytic reforming. The hitch lies not with petroleum chemistry but with engine design.

To sum up the refiners' position with regard to high flash aviation fuel manufacture this paper raises certain questions which must be answered by the aircraft engine designer or the aircraft user before the petroleum chemist can direct his efforts most effectively toward the solution of the problem.

1. What are the *necessary* properties of a high flash fuel from the standpoint of ASTM distillation, flash point, octane number and heating value?
2. Does the aviation industry really want high flash fuels?
3. How quickly will the industry require large quantities of high flash fuels?
4. Can the industry pay a premium for such fuels?
5. Can the aircraft engine manufacturer design an engine to take advantage of the octane number "sensitivity" of aromatic type fuels?
6. Can a "tolerance" in reduced heating value be established in terms of compensating octane number or compression ratio increases?

The choice of approach to the problem of manufacturing high flash fuels rests largely on the answer to the above questions. If the industry is willing to pay a premium price for high flash fuels of high octane number, and if quantity production is not essential except as a long-term project, it should be entirely feasible to produce a paraffinic type high flash fuel of almost any knock rating thus far considered. On the other hand, if the industry is anxious to have a low-cost fuel, if the engine manufacturer can design an engine to appreciate the performance of aromatics, and if advantage may be taken of aromatic type fuels to counterbalance the probably greater specific fuel consumption, then the choice would be a fuel of aromatic type as produced by catalytic cracking or by the catalytic reforming process. The aviation engine industry can assist vitally in bringing the high flash aviation engine fuel to a practical realization by giving the fuel manufacturer sound answers to the foregoing questions.

Hydrogenation of Petroleum—E. V. Murphree, C. L. Brown and E. J. Gohr, in INDUSTRIAL ENGINEERING CHEMISTRY, Vol. 32 (1940), No. 9, pp. 1203-1212.

This paper is a summary of developments in high-pressure hydrogenation with special reference to production of aviation gasoline, aviation blending agents, motor fuel, Diesel fuel and the conversion of heavy asphaltic fractions. Beginning in 1927 hydrogenation has been adopted to the following applications:

High-octane-number aviation gasoline production from kerosene and gas oil fractions.

Motor gasoline production from gas oils.

Aviation blending agent production by saturation of branched-chain polymers.

Production of high-grade Diesel fuels from low-quality gas oils.

Production of water-white paraffinic kerosenes from inferior-quality distillates.

Production of high-viscosity-index lubricating oils from poor-quality lubricating distillates.

Refining (or "hydrofining") of gasolines to low sulfur content and high stability.

Conversion of asphaltic crudes and refinery residues into lower boiling gas oils of increased paraffinicity.

Preparation of low-aniline-point high-solvency naphthas.

Preparation of high-flash high-octane-number safety fuels.

At present, commercial hydrogenation for lubricating oils, solvents, and kerosenes has been superseded by solvent extraction methods. No commercial application of hydrofining has been made.

All these applications except hydrogenation of polymers are examples of destructive hydrogenation at about 200 lbs. pressure. Temperatures are varied according to products desired. The catalysts used may be selective or non-selective, again in accordance with the end in view. The gasolines produced are low in sulfur and have high lead susceptibility.

Aviation naphtha is manufactured by high-pressure hydrogenation of low-grade virgin kerosenes high in cyclics, using a selective catalyst. The octane number of the hydrogenation product is higher than that of much available natural naphtha, but not all feed stocks will give high-octane gasoline on hydrogenation.

High-octane blending agents are obtained by hydrogenizing polymerized derivatives of butylene. Large refineries having a large excess of olefins complement the polymerizing-hydrogenizing process with the alkylation process. Satisfactory paraffinic aviation safety fuels are prepared by the hydrogenation of polymers in the C_{12} range.

To produce the highest quality Diesel fuels hydrogenation is best carried out once-through on virgin or lightly cracked gas oils over non-selective catalysts; however, if the market for this fuel increases so that lower grade materials must be used, hydrogenation will come into competition with solvent extraction because of better yields of higher grade products.

Hydrogenation at high pressures is a useful tool of conversion of tars, pitches and other very low grade materials into useful products, but this has not yet been done commercially in the United States.

The hydrogenation process has as a fundamental advantage the fact that for a given quantity of product less crude is required. This results from the better yield obtained through production of less gas and the absence of tar or coke formation. The crude saving must pay for the added cost of supplying the product by hydrogenation over other methods of producing the same quantity and quality of material. The above applies directly to production of gasoline. It is evident that the economics of hydrogenation are influenced strongly by the price of crude, particularly by the spread between crude and fuel oil. Since the upper price for fuel oil is fixed by competition with coal, it appears that with the latter value established, further increases in crude price directly improve the economics of hydrogenation. Particular emphasis is placed on motor fuel production because of the importance of this product.

It is figured that to make hydrogenation attractive there should be a spread of roughly $0.33 per bbl. between crude oil and fuel oil. With conditions as they were in the first half of 1939 hydrogenation showed about a 20 percent return.

Hypochlorite Used for Refining Certain Roumanian Petroleum Fractions—P. Staehelin, V. Cerchez and A. Catulescu, in MONITEUR PETROLE ROUMAIN, Vol. 41 (1940), No. 13, pp. 723-728.

The use of hypochlorite for treating light distillates is new in Roumanian practice and has required some study. The best conditions are as follows: concentration of the hypochlorite solution, three-tenths normal; quantity of hypochlorite solution by volume, 20 percent of the amount of distillate; working temperature 20 deg. to 25 deg. C.; free alkali in hypochlorite solution per liter, 0.8 gram.

Cracked gasolines which have passed through the Gray process with a positive doctor test are given a caustic wash and a hypochlorite wash; after this treatment the doctor test is negative and the gasoline has all the properties of gasoline that has passed through the lead plumbite process, and the color is better. A similar result may be had by using a water solution of chlorine, but the hypochlorite method is much more convenient.

Correlation Index to Aid in Interpreting Crude Oil Analyses—Harold M. Smith in BUREAU OF MINES TECHNICAL PAPER 610 (1940); 34 page.

The correlation index is a number whose magnitude indicates certain characteristics of a crude oil distillation fraction. If a fraction were composed exclusively of normal paraffin hydrocarbons, the value of the index number would be zero. If the fraction be from a paraffin-base crude oil of the usual type, its index will not be zero but will be small, while fractions from intermediate and naphthene-base crude oils will have increasingly greater values for the indexes.

The meaning of the index is best shown by considering a Bureau of Mines Hempel analysis including correlation indexes, of an intermediate-naphthene-base crude oil from the Plymouth field, Texas.

SAMPLE N, PLYMOUTH FIELD, TEXAS
Dry Distillation at 743 MM. First Drop, 46° C. (115° F.)

Fraction No.	Cut at— °F.	Per-cent	Specific gravity 60/60° F.	C.I.	Sum, percent
1.....	122	.....	.....	.....	.....
2.....	167	3.2	0.675	.....	3.2
3.....	212	4.7	.708	16	7.9
4.....	257	9.6	.737	20	17.5
5.....	302	7.1	.758	23	24.6
6.....	347	8.2	.777	25	32.8
7.....	392	7.9	.800	30	40.7
8.....	437	7.9	.815	31	48.6
9.....	482	9.8	.835	35	58.4
10[1].....	527	12.9	.858	41	71.3
Dry Distillation at 40 MM.					
11.....	392	8.5	0.889	27.7	79.8
12.....	437	5.1	.902	25.4	84.9
13.....	482	5.1	.925	21.5	90.0
14.....	527	1.3	.945	18.2	91.3
15[2].....	572	4.4	.965	15.1	95.7
Residuum	.....	3.2	1.020	7.2	98.9
Distillation loss	.....	1.1	.....	.....	100.0

The column headed "C. I." gives the index values for each fraction and at once indicates that this crude oil contains a wide range of hydrocarbon types. Index values of 16 to 24 are usual for paraffin-base crude oils, so it is evident that the lower-boiling material resembles fractions from crude oils of this type. The higher index values for the last several fractions of the distillation at atmospheric pressure indicate increasing amounts of cyclic compounds, a conclusion verified by the increasingly high indexes for the last vacuum fractions. On the basis of these indexes it appears that the antiknock value of the straight-run naphtha, due to the presence of cyclic compounds, would be somewhat better than the usual paraffin-base naphtha, but that the aniline points of the burning oils would be low, indicating that these fractions could perhaps best be used as cracking stock or for other purposes not requiring a predominantly paraffinic type material. The analysis also shows the presence of a considerable amount of viscous lubricating stock, but the high values of the indexes, probably due to the occurrence of aromatic rings, indicate that probably at best only very low yields of high-quality lubricating oil could be made.

The method of calculating is given in detail in the original publication which should be consulted.

The Houdry Process and its Relation to the Diesel Industry—W. S. Mount and E. T. Scafe, before Oil and Gas Power Division, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Asbury Park, June, 1940.

The Houdry process, which is now being used for the production of high anti-knock gasoline, also will produce at the same time high yields of distillate fuel suitable for use in the great majority of diesel engines. A comparison between Houdry catalytic cracking and thermal cracking is made. It is shown that for a given requirement of distillate fuel oil suitable for diesel fuel, the use of Houdry equipment enables the production of equal or better quality diesel fuel and larger yields of higher anti-knock quality gasoline than in cases where thermal cracking only is employed. The physical properties of Houdry diesel fuels are discussed and comparisons made with straight-run products. The comparison between the two products will depend on what percentage of gasoline is produced; the greater the run to motor fuel the lower the cetane number of the Houdry product.

ASPHALT & TAR

Rubber Strip Test for Bituminous Binders. H. C. Bennett and D. W. Parkes in HIGHWAY RESEARCH ABSTRACTS 1940, pp. 3-4.

The development and improvement of bituminous binders has been difficult because of the lack of a rapid and reliable method of evaluating the properties of the binder in the laboratory. The test described in this article, is the result of considerable experimentation in both laboratory and field to develop a means of determining the durability of binders in the laboratory. Essentially the test consists of applying a thin film of the binder 0.005 inch to a strip of rubber, exposing it to some form of accelerated weathering, and then elongating the rubber strip at varying temperatures, noting when the film cracks.

The authors believe that the main changes occurring during natural weathering are due to loss of oils and that the effect of ultra-violet light and oxidation are of lesser importance. The strip test outlined in the article has been correlated with a series of accelerated carpet tests. Further studies are now in progress.

The Relation of Asphalt Road Construction to the Automotive Industry—E. W. Klinger, A. Holmes, and R. F. Phillips, Standard Oil Development Co. before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit September, 1940.

The rapid expansion of the use of the automobile has accentuated the demand for improved roads by which the motoring public can achieve greater enjoyment and speed in their driving. This has led to the construction of bituminous road adapted to various traffic conditions and most recently to bituminous soil stabilization. Recent developments in the use of wetting agents permit the construction of bituminous pavements under adverse moisture conditions for which untreated bitumens would be unsuited. The in-

creased mileage of paved roads, largely of the bituminous type, is contributing greatly to riding comfort and lowered costs of car operation and is also affecting the design of the motor car.

USES

The Application of Phenolic Compounds and Metal Derivatives Thereof as Lubricating Oil Addition Agents—O. M. Reiff, Socony-Vacuum Oil Company before Division of Petroleum Chemistry, AMERICAN CHEMICAL SOCIETY, Detroit, September, 1940.

New types of metal organic addition agents for lubricating oils have been developed from alkylated phenolic compounds. By the introduction of alkyl substituents derived from petroleum wax, multifunctional addition agents are formed which are capable of imparting combined properties such as pour point depressant action, improved V. I. and antioxidant value to lubricating oils. The effectiveness of the multi-functional addition agents is improved by the introduction of metal substituents, particularly in respect to antioxidant value. Attention is directed to the importance of the type of solubilizing radical as well as the kind of metal substituent in the formation of metal organic addition agents having antioxidant value.

The Significance of Diesel Exhaust-Gas Analysis—John C. Holtz and M. A. Elliott, before Oil and Gas Power Division, AMERICAN SOCIETY OF MECHANICAL ENGINEERS, Asbury Park, 1940.

In an investigation by the Bureau of Mines the composition of the exhaust gases from two four-stroke-cycle four-cylinder Diesel engines in proper mechanical condition has been determined by precise analytical methods for fuel-air ratios ranging from approximately 0.01 to 0.9 lb. per lb.

The variation of exhaust-gas composition with fuel-air ratio is shown and indicates that combustion was essentially complete when excess air was present. When the two engines were operated in their normal range of fuel-air ratios the concentration of carbon monoxide never exceeded 0.12 percent, and hydrogen and methane were never present in significant concentrations.

Despite such low concentrations of carbon monoxide it was observed that the concentration of this gas was affected not only by fuel-air ratio but also by engine design and to a slight extent by factors that varied with engine speed. In tests of both engines the concentration of carbon monoxide reached a minimum at a fuel-air ratio of approximately 0.03 lb. per lb.

Aldehydes, which are intermediate products formed in the direct oxidation of hydrocarbons, were present in the exhaust gases from both engines. The concentration of these compounds never exceeded 31 parts per million and tended to increase as the fuel-air ratio was decreased. Preliminary studies have indicated that aldehydes may be partly responsible for the so-called acrid exhaust from Diesel engines.

Throughout the normal operating range of both engines, free carbon was collected on filter paper through which exhaust gas was passed. Under these conditions the final exhaust generally was clear, although the calculated quantity of free carbon in the exhaust gas from one of the engines ranged from 2 to 6 percent by weight of the fuel. Free carbon in the exhaust increased rapidly at fuel-air ratios greater than the maximum ratio in the normal operating range, and when the concentration of free carbon reached approximately 0.3 lb. of carbon per 1000 cu. ft. of exhaust gas, smoke was easily noticeable.

The presence of aldehydes in the exhaust is indicative of chilling of direct oxidation reactions, and the presence of free carbon at fuel-air ratios on the lean side is indicative of chilling of destructive (cracking) combustion reactions occurring in locally overrich regions.

In the normal operating range of one engine the potential heat lost in the products of incomplete combustion was between 1.5 and 5.5 percent of the energy in the fuel. Such low losses might not be detected unless precise methods of analysis were used.

The Combustion-Gas Turbine—J. T. Rettaliata, before Oil and Gas Power Division, AM. SOC. MECHANICAL ENGINEERS, Asbury Park, June, 1940.

The author is in a position to state that the numerous obstacles in the path of the development of the modern combustion-gas turbine have been adequately surmounted. Years of metallurgical and aero-dynamical research, resulting in better materials and an efficient compressor, are the factors which contributed most to the realization of a commercial gas turbine. Its advantages, when compared with other methods of power production, are manifold. Many new uses to which it can be profitably applied are anticipated when additional experience is obtained.

This paper deals with the development and theory of the gas turbine, as well as the features which make it possess attractive potentialities for certain classes of service.

The principle of the combustion-gas turbine is practically identical with that of a steam turbine and comprises a gas turbine, an axial compressor, an oil burner, a generator and a starting motor.

At the present time the principal commercial application of the gas-turbine axial-compressor unit in the United States has been in oil refineries. Air discharged from the compressor is used in a process and the resulting high-temperature gases are expanded in the turbine, producing power, the excess of which is supplied to a generator. In this arrangement, no combustion chamber is required as the process itself acts in this capacity.

Many gas-turbine axial-compressor units operate as super-chargers in the Velox boiler, developed by Brown-Boveri, where the boiler-exhaust gases drive the turbine.

Investigations are under way to apply this principle in the construction of gas turbines as a drive for locomotives of large size. One such locomotive has been built with 5000 h.p. capacity, 90 percent of which is delivered at the axle.

BOOKS

Simple Blue Print Reading with Special Reference to Welding, published 1940 by THE LINCOLN ELECTRIC CO., Cleveland, Ohio. 138 pages, 6 x 9, 164 illustrations, 50 cents.

This book affords a basis for study of blue print reading which, together with practice in the actual reading of drawings, will guide the student to proficiency in this important subject. While the book has been compiled and published primarily for welders, it contains information of value for anyone concerned with mechanical construction. With the help of the book, the student can learn with a few hours' spare-time study what it would take many months to pick up in the ordinary course of everyday work. It will enable welders, mechanics and others to answer question for themselves, thus saving the time of the welding supervisor or foreman.

Annual Report of Railroad Commission of Texas, 1939; 443 pages.

In this report the Commission notes that during 1939 Texas produced 476,550,000 bbl. of crude oil, which was 0.15 percent above 1938 production but 6.62 percent under the 1937 total. The number of producing wells continued to grow, but at a lesser rate than in previous years. This slowing down of development has undoubtedly been due to price changes and the trend toward wider spacing, but it is probable that the primary tendency leading to drilling curtailment in recent years has been the consistent reduction in well allowables and the resultant extension of the payout period. There is also noted a decline in the daily average production of Texas oil wells, which was 18.1 bbl. in 1937, 15.3 bbl. in 1938, and 14.5 bbl. in 1939. While this slowing down in the rate of drilling is encouraging in that it retards the year-to-year decrease in well allowables, some concern is felt on account of its possible effect on the rate of discovery of new fields and the maintenance of adequate reserves of oil. However, new discoveries in 1939, together with revaluations and extensions of existing fields have added an estimated 1,800,000,000 bbls. to Texas oil reserves. Still, the problem of the Texas oil industry is to discover new markets rather than new fields. The growth of the reserves of course adds to the expectancy of life of the 123 refineries in the state.

The body of the volume is taken up with an account of the administrative functions of the Petroleum Division of the Commission.

Business Law of Colombia, Including Oil Mining, Labor and Tax Legislation, by James Wallace Raisbeck, Jr.; published 1940 by Jarrett Printing Co., Charleston, W. Va.; 448 pages.

The review of this book may well begin with the statement that it is one that every business man who has or contemplates business dealings in Colombia should own and become familiar with. This applies especially to those who have or may have investments in Colombian enterprises, or have private property subject to the provisions of Colombian law.

The author is particularly well qualified to interpret Colombian law to outsiders, especially to American capitalists looking for likely fields in which to invest their capital. He is a member of the West Virginia bar who has become domiciled in Bogota as a practicing attorney and has been made a lecturer in law at the Free University of Bogota; his familiarity with Colombian jurisprudence is attested by his previous book on Colombian petroleum legislation and his book on the Colombian income tax.

In this volume he makes a substantial survey of Colombian business legislation and corporation law. First of all he takes occasion to remind foreign readers that Colombia, while not the largest or the most populous country of South America, can justly claim first place among South American countries for the freedom and independence of its institutions. Colombia, he says, is a democracy not only in principle but also in fact. With his American antecedents we may consider Mr. Raisbeck qualified to recognize a real democracy when he sees one. His appraisal of Colombia as a genuine republic would seem to be borne out by the political history of the country; every one of the last ten changes of government

has been by the orderly process of free suffrage and not by revolution. This is quite a record for Latin America.

Under the National Constitution private property and vested rights are protected by a judiciary that is really independent and above partisan or executive pressure; Colombian law can thus be taken at its face value with as much confidence as in the United States.

But it is necessary for the foreign enterpriser to know what the law is, which means that he will become acquainted with what is required of the administrators of capital invested in the country. A major purpose of Colombian social-economic legislation is to protect workers from conscienceless exploitation and to promote the development of the national resources as much as possible in the general interests of the country, as well as in the interests of those who furnish the necessary capital. Investors who comply with the spirit of this legislation, says Mr. Raisbeck, will be assured of a square deal.

The book comprises 17 chapters which set forth and explain the laws governing petroleum production and mining, labor legislation, industrial property, traffic in parmaceuticals, the general law on sales, agencies, powers of attorney, accounting and negotiable paper. There is a chapter on foreigners, their status and rights; another on foreign and domestic corporations, and another on partnerships. The last three chapters deal with exchange control, taxation, and insurance. An appendix gives the rules relating to exports to Colombia. Finally, there is a good index.

Altogether the author appears to have succeeded very well in providing a useful manual on the subject.

Roumanian Seizure of Oil Properties

PRESS reports from Bucharest state that under a decree issued by Gen. Antonescu, head of the Roumanian government, all pipe lines, pumping stations and reservoirs, together with the land on which they are located have been taken over by the government.

A second decree, according to the same reports, ordered the seizure of all river barges, tugs, tankers and seagoing ships owned by companies having Jewish stockholders.

Payment for the properties thus taken is to be made in bonds bearing three percent interest which are to be retired gradually over a period of twenty-five years.

The reports did not mention specifically the status of producing wells and of refineries though in the case of one of the largest companies it had been reported previously that the government had taken control of all its properties.

In well informed quarters a specific reason for the government's action was held to be the desire of German military authorities, now in control in Roumania, to speed up shipments of oil to Germany. By putting all transportation facilities in the hands of the authorities movement of the rather large stocks held in storage might be accelerated. In the reports referring to the expropriation of these properties it was stated that production had fallen from 130,000 bbl. daily to around 100,000. While the reason officially given for this decline was lack of available transportation private advices were that the recent earthquakes and disorders in the oilfields were largely responsible.

Dies In Airplane Crash

IN the crash of a United Airlines transport plane at Chicago December 4, Charles W. Manville, general sales manager of National Refining Company received injuries from which he died the following day. Paul Ryan, president of the company, was seriously injured in the crash but is reported to be recovering.

U. S. Pipe Lines to Handle Venezuelan Oil

SHIPMENTS of Venezuelan crude oil directly across the United States will begin during December. This will result from an arrangement by which crude from Eastern Venezuela delivered by tanker at Marcus Hook, Pa. will be carried through Susquehanna and National Transit pipelines to Colegrove, Pa., thence by Northern pipelines to Cygnet, Ohio, and through the Buckeye system to a connection with the line recently constructed by Imperial Oil Ltd., leading to its refinery at Sarnia, Ontario. Movement of 10,000 bbl. daily is contemplated by this route which will require no new construction except some storage at junction points.

U. S. MACHINERY EXPORTS

(Continued from page 33)

business of the United States in oilfield equipment. It has caused some shifting of markets, giving increased importance to certain countries of the western hemisphere as well as to India, Burma and the Soviet Union. In those countries in which exploratory drilling has been slowed down the interruption is only temporary and operations will be resumed with increased activity as soon as the war ends or its theatre shifts to an extent that will permit the release of shipping now unavailable for ordinary commercial service.

A much greater decrease has taken place in exports of refining machinery than in that of field equipment in the period under comparison. This was not due entirely to the war. Several large programs of refinery construction and enlargement reached completion during 1939 which was a year of record activity in this field so that imports into these particular areas probably would have shown some decrease in 1940 regardless of war developments. This was the case in Netherlands India, Netherlands West Indies, Iran, Venezuela and some other countries. Palestine, for example, figured in the list of important importers in 1939 to the extent of roundly $3,500,000. This was due to the construction of the refinery at Haifa which was completed in that year.

The war did have the effect, however, of postponing plans that were virtually completed at the time of its beginning for the construction of several large refineries which would have required millions of dollars worth of equipment. Other important projects were delayed because of the impossibility of obtaining the necessary machinery from the United States which was the only country remaining that might have been capable of supplying it.

Table IV shows the changes that took place during the first year of war, as compared to the year immediately preceding, in shipments of refining equipment to principal importing countries. As against the decreases in exports to a number of these countries the statistics show increases in shipments to others, including the United Kingdom, France, Trinidad, Canada and Mexico. While exports of this class of machinery were less following the outbreak of the war than in 1937 and 1938 they were larger than in any preceding year prior to 1936.

Resumption of the export trade in refining machinery on a scale larger than ever before, as soon as hostilities cease, appears even more certain than in the case of drilling equipment. Refineries have been the favorite targets of aerial bombers in Europe and the destruction of plants already has reached tremendous proportions. Reconstruction of plants and provision of new facilities will tax the capacity of engineering and manufacturing organizations as soon as peace is restored.

TABLE III

U. S. Exports of Drilling Machinery By Principal Countries

	Sept. 1938 Aug. 1939	Sept. 1939 Aug. 1940
Venezuela	$3,951,321	$3,670,404
Argentina	1,515,516	2,670,152
Trinidad	1,520,321	1,543,968
British India and Burma	1,011,692	1,515,515
Canada	1,191,519	1,430,742
Soviet Union	231,331	1,049,637
Colombia	2,262,385	965,896
Netherland India	2,324,882	735,111
Saudi Arabia	835,733	440,492
Egypt	666,433	376,856
Mexico	116,644	323,579
Brazil	155,596	289,597
Others	4,104,152	4,298,786
Total	$19,887,525	$19,257,735

TABLE IV

U. S. Exports of Refining Machinery By Principal Countries

	Sept. 1939 Aug. 1939	Sept. 1939 Aug. 1940
United Kingdom	$ 136,590	$1,540,292
Netherland India	1,934,637	1,214,396
France	68,161	1,106,101
Netherland West Indies	4,850,911	762,968
Argentina	1,247,755	695,493
Venezuela	1,297,951	500,014
Mexico	62,310	305,014
Trinidad	139,014	304,459
Canada	200,281	299,105
Colombia	268,887	248,124
India and Burma	353,190	220,701
Iran	935,388	175,647
Other	6,663,315	2,013,428
Total	$18,158,390	$9,385,742

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Annual Review of California's Oil Industry

Petroleum World Annual Review. Published 1940 by PETROLEUM WORLD, Los Angeles, Calif., 9 x 12 inches, 350 pages, $2.00.

The present edition is the eighth of the annual reviews of the California petroleum industry, published by PETROLEUM WORLD. This publication continues to be unique in its field, and to be distinguished by the minuteness and great fullness of detail with which it reflects the activities of California oil producers. As usual, drilling operations are chronicled by fields and by companies with totals for prior years, along with a complete California dry hole record. Production figures are given by fields, years, months, and companies, with oil well completions and oilfield discovery data for all California fields. There are records of the prices of crude oil by fields, refiners' stocks and a refinery and natural gasoline plant census. The market section deals exhaustively with sales, local and interstate trade, and offshore shipments. The oil fields of California are mapped, and the statistics of production are presented graphically in charts. In this brief summary it is hardly possible to convey an impression of the great extent of readily comprehended detail which is to be found here.

The volume, however, is not merely a statistical reference book. A number of articles of general interest are here published, including a review of new drilling equipment by W. H. Farrand; new production methods and equipment by E. C. Babson, and twenty years of petroleum geology, by Roy M. Barnes. The editors supply an exposition of trends in the natural gasoline industry and a forecast of the important year that is ahead of the refiner. The numerous illustrations are superbly executed and there are photograph-portraits of 276 prominent men of the machinery trade who among others supply the equipment needs of California oil producers.

Drilling Contractors Organize

Organization of the American Association of Oil Well Drilling Contractors was completed at a meeting held in Chicago on November 13 in connection with the annual convention of the American Petroleum Institute. Officers of the association were elected as follows:

J. E. Brantly, Drilling & Exploration Co.; Los Angeles, President;

Harry L. Edwards, Houston, Vice President at Large;

W. S. Churchill, Arrow Drilling Co., Tulsa, Vice President for Rotary Drilling;

J. J. Klise, Wooster, Ohio, Vice President for Cable-tool Drilling;

C. J. Paine, Paine Drilling Co., Dallas, Secretary-Treasurer.

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as it may have appeared to be in the past, the job of transporting petroleum, aviation spirit and fuel oil safely and economically was never so vital a duty as it is to-day, when it is absolutely essential to the co-ordination of the national effort. Communications by road and by air depend upon it, and where bulk supplies are entrusted to BUTTERFIELD Road Tanks the job will be well done. These robust Tanks carry their responsibilities readily.

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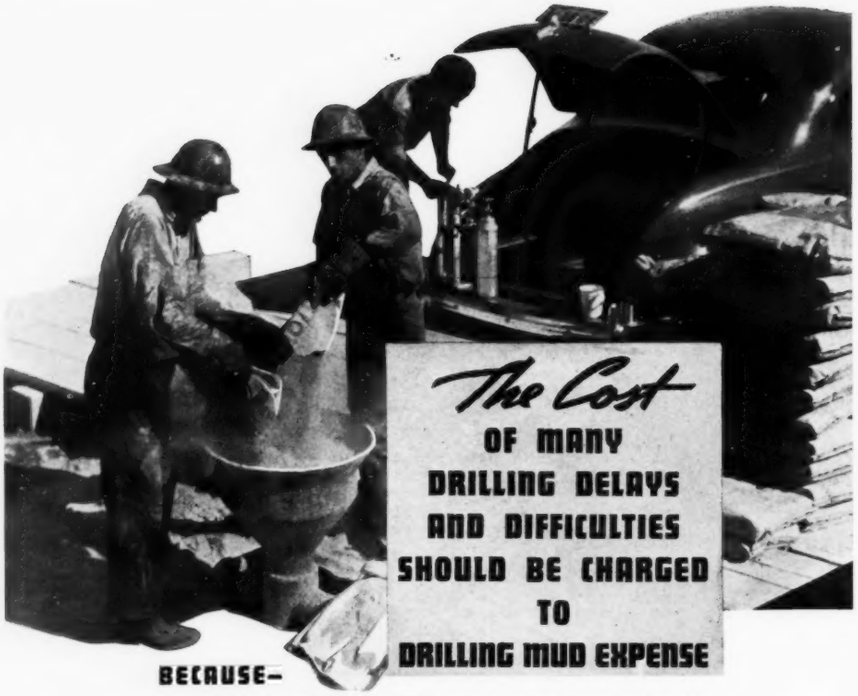

The Cost
OF MANY
DRILLING DELAYS
AND DIFFICULTIES
SHOULD BE CHARGED
TO
DRILLING MUD EXPENSE

BECAUSE—

Stuck pipe, which is one of the most commonly encountered troubles, is usually caused by improper mud. The reasons for stuck pipe are usually caving of the hole, settling of cuttings, or a thick mud cake. Mud which is properly selected for the specific drilling conditions can eliminate these drilling troubles.

One expensive fishing job (which might be eliminated by suitable mud) may be much more costly than the slightly higher cost of using the proper mud on a great number of wells with complete safety. Muds of slightly increased weight and suitable colloidal content provide protection against these troubles at minimum cost.

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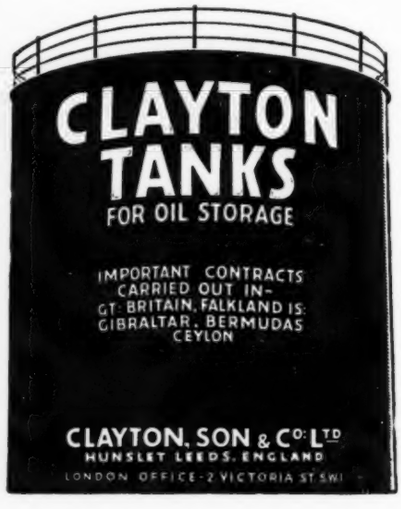


Venezuela's Place in the Sun

MODERNIZING A PIONEERING COUNTRY, by Nicholas Roosevelt: Published by Round Table Press, Inc., New York, 1940, 88 pages. Illustrated. Map.

After Simon Bolivar, oil ranks as the greatest liberator of 3,500,000 Venezuelans living in that part of the torrid zone touching the Caribbean Sea on the north and the Brazilian jungles on the south. For out of the scarcely tapped deposits of oil beneath the soil of this region came "black gold" about twenty-five years ago initiating an area of industrial development climaxed today by Venezuela's position as the third largest producer of crude oil in the world—some 17,000,000 bbl. monthly—and the development of other resources and public works well on the way.

This and more about Venezuela—its political problems of the past and its hopes for the future—are related by Mr. Roosevelt in this succinct and readable little book, which might serve the tourist as a guide and the student of history as a preliminary introduction.

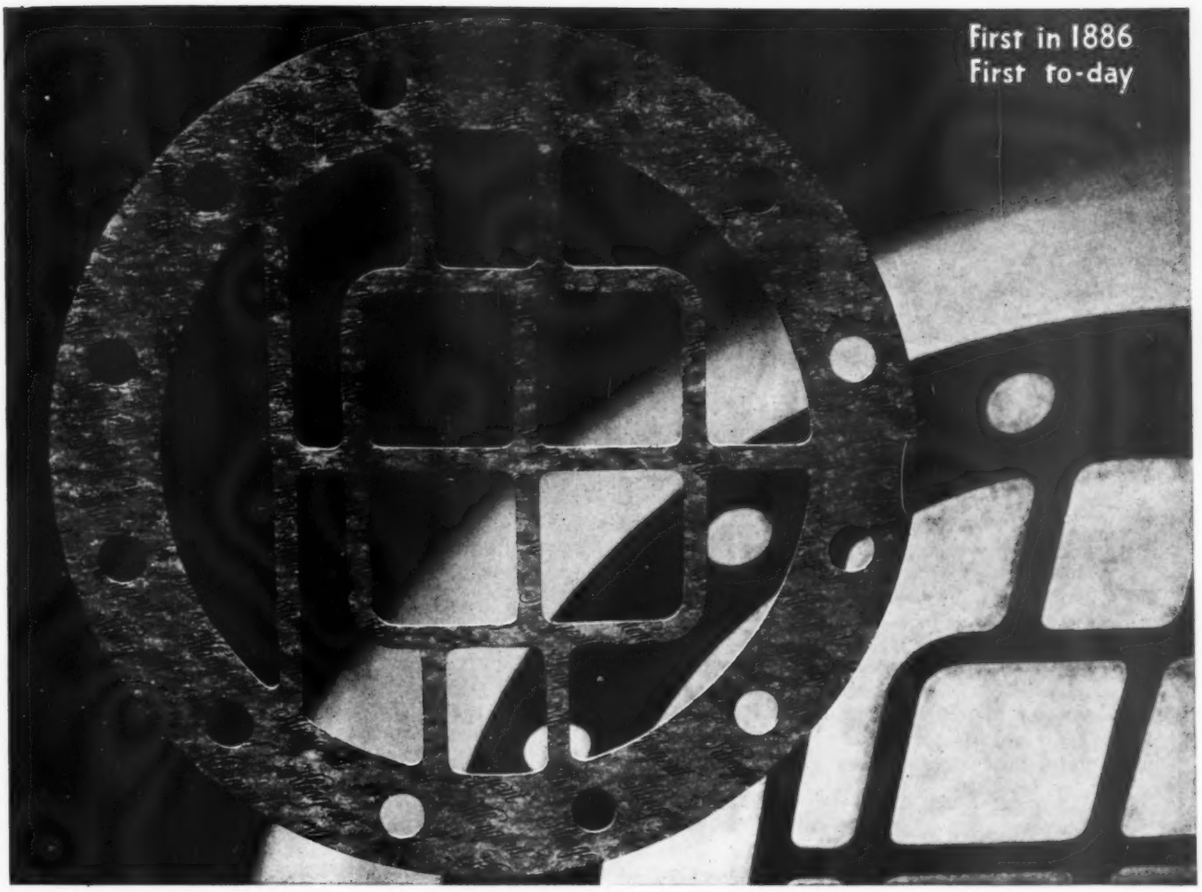
But more than these purposes, in these critical days, it plays its part in the Pan-American program of bettering relations among all the Americas by leading to a better understanding of the peoples and problems of one link in the Pan-American chain. So the author does a service in elucidating the background and customs of this South American country nearest our shores and still in many respects in a pioneering age. But cocoa palms by the Caribbean, oil derricks in Maracaibo and the Caracas University are only high spots in the story of "Venezuela Heroica", which began with Bolivar and already has carried Venezuela to the position of one of the most progressive and prosperous nations in Latin America.

Regional Defense Committee

IN addition to the policy committee of oil company executives recently appointed by the American Petroleum Institute to cooperate with the Advisory Defense Commission on defense measures, particularly the protection of gasoline in storage from sabotage or military attack, a number of regional committees have been named to have charge of this work in different sections of the country.

The national committee includes W. S. Farish, Standard Oil Co. (New Jersey) chairman; H. D. Collier, Standard Oil Company of California; Henry M. Dawes, Pure Oil Company; J. Howard Pew, Sun Oil Company; J. Frank Drake, Gulf Oil Corporation; W. S. S. Rodgers, The Texas Company; George A. Hill, Houston Oil Company; W. G. Skelly, Skelly Oil Company; J. C. Hunter, Mid-Continent Oil & Gas Association, Frank Buttram, Independent Petroleum Association; C. L. Henderson, Western Petroleum Refiners' Association, and C. L. Suhr, National Petroleum Association.

Regional committees named by W. R.



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Boyd, Jr., executive vice president of the American Petroleum Institute are as follows, the first named member in each instance being chairman and the second vice chairman and secretary.

Northeastern: E. H. Barlow, Standard Oil Development Co. and R. W. Black, Standard Oil Co. of New Jersey.

Southeastern: Wiley L. Moore, Wofford Oil Co. and H. A. Grumman, Sinclair Refining Co.

Great Lakes: L. W. Westcoat, Pure Oil Co. and P.A. Krauel, Standard Oil Co. of Indiana.

Central: J. C. Hunter, Mid-Continent Oil & Gas Association and R. C. Powell, The Texas Company.

Western: R. A. Sperry and B. A. Moeller, General Petroleum Corporation.

GEOLOGY OF BRAZIL

(Continued from page 25)

since the National Petroleum Council was formed in 1938, he has been in the technical division of that government organ. Dr. Leonardos, who is professor of stratigraphy and paleontology of the National Museum in Rio de Janeiro, is a doctor of physical and mathematical sciences. At present he is in Washington, D. C., spending a year in research.

Each of the co-authors has published a large number of articles and reports on Brazilian geology, and they have done more than twenty years of field work in all the states in Brazil. They are extremely well equipped to organize and interpret the large body of technical data on Brazilian geology which has been produced in various languages within the last century, and which is scattered through hundreds of official bulletins and reports.

This work was undertaken at the request of the "Brazilian Commission for the Centeniaries of Portugal", to form part of a complete study of Brazil presented to the Portuguese nation. However, the authors state that the book is not offered simply as propaganda, but as a piece of scientific collaboration. It should, for instance, aid Portuguese geologists in studying the supposed likeness between the geology of the West African Colony of Angola and the State of Bahia.

The present issue is a special edition. The book is suitable, however, for all who wish to obtain a thorough comprehension of Brazil, so many aspects of which are better understood against the geological background. Therefore it is hoped that the popular edition will soon be published.

The clear, straightforward style of this work in Portuguese recommends it to foreign readers. Because of its arrangement, the material can be referred to with ease. Discussion of each era is preceded by generalities, while the ages are presented in chronological order with reference to the states of Brazil where evidences occur. Listed at the bottom of each page are the authorities cited, and an index completes the means of ready reference to the 460 pages. The subject of petroleum geology and prospecting is amply covered.

Of particular interest to foreigners is the dedication, which reads:

"In memory of the geologists

Wilhelm von Eschwege	**(1777-1855)**
Charles Frederic Hartt	**(1840-1878)**
Henri Gorceix	**(1842-1919)**
Orville Adelbert Derby	**(1851-1915)**
John Casper Branner	**(1851-1922)**

for the great services which they rendered Brazil."

The work of these men is explained in an introductory chapter.

Eschwege's "Pluto Brasiliensis", published in 1833, is given as the first work of general importance on Brazilian geology. In 1876, Henri Gorceix was invited to come from France to organize and direct the Ouro Preto School of Mines, which is still the principal training college for Brazilian engineers.

Charles F. Hartt, the Canadian born geology professor at Cornell University, came to Brazil at the head of the Morgan Expeditions from Cornell, accompanied by a party of his students, notably Orville Derby. Hartt put Brazilian geology on a sound basis by study of the fossils, hitherto neglected, and became founder and director of the first Geological Service, in the time of the Empire, on which commission Derby and John C. Branner were employed. This year the Brazilian Academy of Science observed Hartt's centenary, acknowledging him the "father of Brazilian geology."

Hartt died very young, while Derby remained in Brazil many years, during which his principal work was as director of the Geological and Mineralogical Service. According to this volume, his services to Brazil have never been equalled by any other geologist, Brazilian or foreign.

Branner, who became president of Stanford University, California, wrote more than 75 papers on Brazilian geology, including a resume published 1919 (Geological Society of America, vol. 30, pp 189-338). His Geological Map of Brazil, published by the above society in 1918, has been superseded only in 1938 by Dr. Avelino de Oliveira's map for the Ministry of Agriculture, a copy of which accompanies the volume under review.

"Geologia do Brasil" contains copious illustrations, some hitherto unpublished. Besides original diagrams by the authors, there are sketches after Branner, Derby, and many others, and full page plates, notably after the distinguished American invertebrate paleontologists, C. A. White, J. M. Clarke, and Dr Carlotta J. Maury, all of whom contributed work of lasting value to the study of Brazilian fossils.

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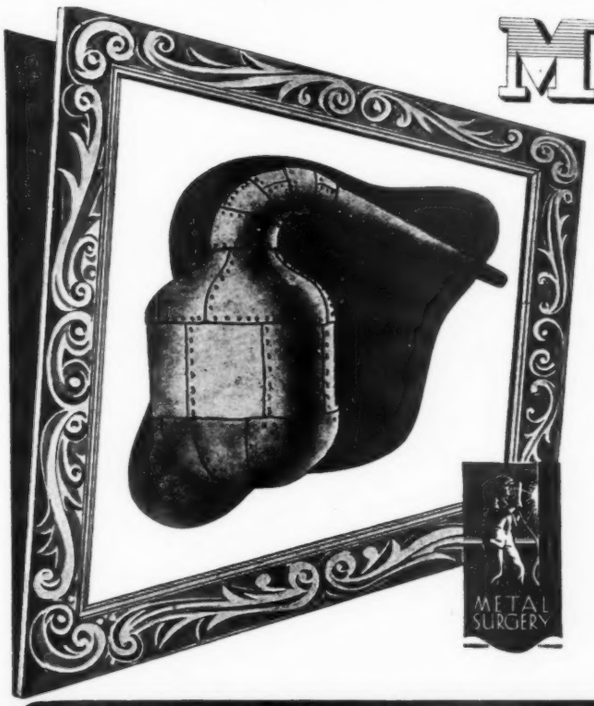

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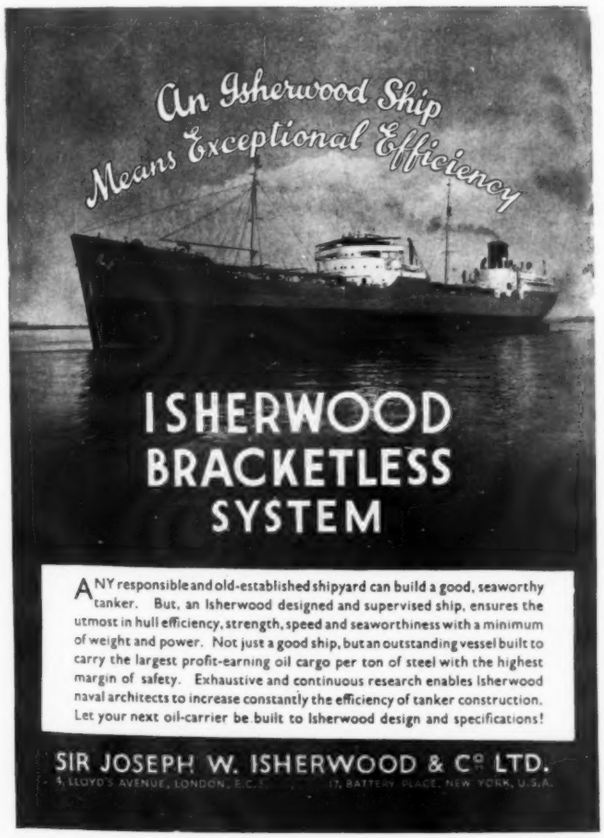

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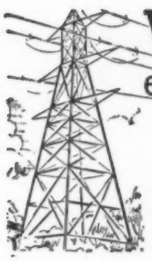

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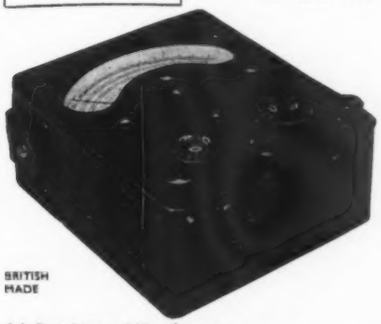

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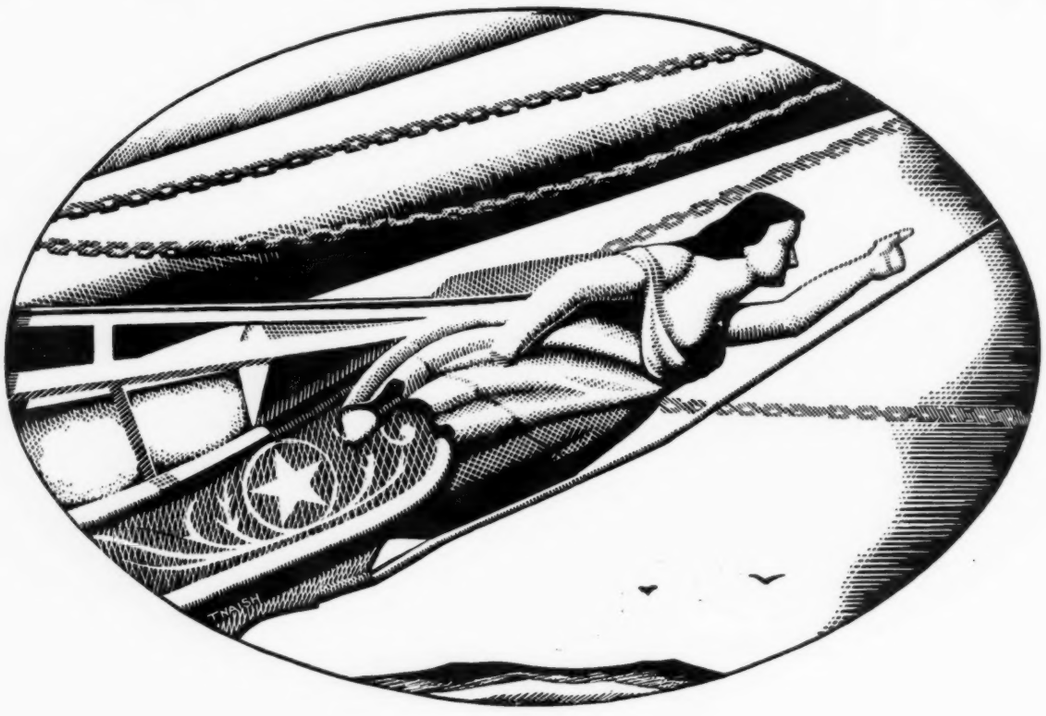

"CUTTY SARK"

NO SERIES of figureheads could ever be complete without the "CUTTY SARK'S", perhaps the best-known of them all. Designed to represent the incident in Robert Burns' famous poem of Nannie, in pursuit of Tam O'Shanter, she was made by Hellyer of Blackwall in 1869 and it was the custom, when the "CUTTY SARK" was in port, to put a horse's tail in Nannie's outstretched hand in memory of the old mare's tail the witch pulled out. Later, when the "CUTTY SARK" was running down her easting in the "roaring forties" she lost this arm and an inferior substitute had to be provided which she carries to this day. The meaning of the words "cutty sark" is probably common knowledge today, though, whether it was through ignorance or a regard for the proprieties, the flowing draperies with which Hellyer covered his beautiful model would seem far removed from Burns' "cutty sark" or short shirt which Nannie wore on the Hallowe'en revels.

Through the public spirit of her late owner, Captain Dowman, the "CUTTY SARK" is now preserved for all time from the fate which has befallen most of her famous rivals and Nannie can grow old in peace as she watches a new age of ships sail down the Thames. Progress has decreed that only the most modern methods of travel can succeed upon the sea today and so Shell plays its part in ensuring unfailing supplies in ports throughout the world to the proud successors of the old sailing ships.

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BAKER'S *Contribution* TO THE SCIENCE OF OIL WELL CEMENTING . . .

THIRTY years ago, the possibility and advantages of using cement to shut off water in oil wells was just becoming recognized. But there were problems . . . such as how to put the cement away and how to place it in such a manner that a perfect cement job would result.

As usual, when a need arises, someone, somewhere, figures out a method and a means for getting the job done. Among the early pioneers in the cementing art was R. C. Baker, and the method he figured out resulted in the invention and development of a line of special cementing devices such as the Baker Cement Retainer, Sure-Shot Cement Plug, Cement Dump Bailer and later, the now famous line of Baker equipment for Guiding, Floating and Cementing Casing, containing a "floating" unit with plug made of special Baker-Formula Concrete into which was anchored a positive-acting Bakelite Ball-Type Back-Pressure Valve. This gave to the industry for the first time, real meaning to the words STRENGTH — VALVE EFFICIENCY and *DRILLABILITY* as applied to Guiding, Floating and Cementing Equipment.

Still striving for better cementing results Baker more recently introduced Shoes and Collars with baffled side ports . . . these baffled ports imparting to the cement slurry a whirling action which greatly facilitated the effectiveness of the cement job by placing a more nearly uniform body of cement around the Shoe and up and around the casing . . . minimizing the ever-present hazard of channeling . . . a distinct contribution to the art of oil well cementing.

Coincidental with the later development of Baker Float Shoes, Float Collars and other similar casing equipment, there arose the need for an *improved* Cement Retainer . . . one which would achieve results where everything else had failed . . . a device, for example, that would permit putting away cement under extremely high pressures, pressures greater than could safely be used by other means of cementing; a device that would permit doing a cement job at any point behind the casing or in the open hole by applying a "squeeze" to the cement and holding the pressure on it without the aid of surface equipment. Baker provided the solution of these difficult problems by giving to the industry the *Baker Model K Cement Retainer*. From its inception, this amazing tool was destined to be successful.

Experience gained from the running of thousands of Cement Retainers influenced certain changes in the design, construction and operation of this device . . . changes necessary to meet the trend in modern oil well drilling and completion methods. Today the Baker Model "K" Cement Retainer stands alone in its field as an amazing device that has consistently performed the "impossible" . . . and in doing so, has justly earned its reputation, along with Baker Cement Guiding, Floating, Cementing Equipment, as being an outstanding contribution to the science of oil well cementing.

BAKER OIL TOOLS, INC

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